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MODERN SEARCHLIGHTS.

BY FRANK C. PERKINS.

A new form of electric flashlight has been installed in the lighthouse tower at Heligoland by the Siemens-Schuckertwerke, of Nuremberg, Germany. The searchlights or projectors used at this installation are combined, as shown in the views on another page. There are three lower searchlights, arranged 120 degrees apart, and another mounted upon the top, all operated automatically and driven by electric motors. The carbons, which are fed by automatic mechanism, are placed in a horizontal position, as is usual with most large searchlights. The intensity of the light is 30 million candle power as a minimum, and the maximum current used is 100 amperes. The light flashes occur every 5 seconds, and they remain in one position only .1 second.

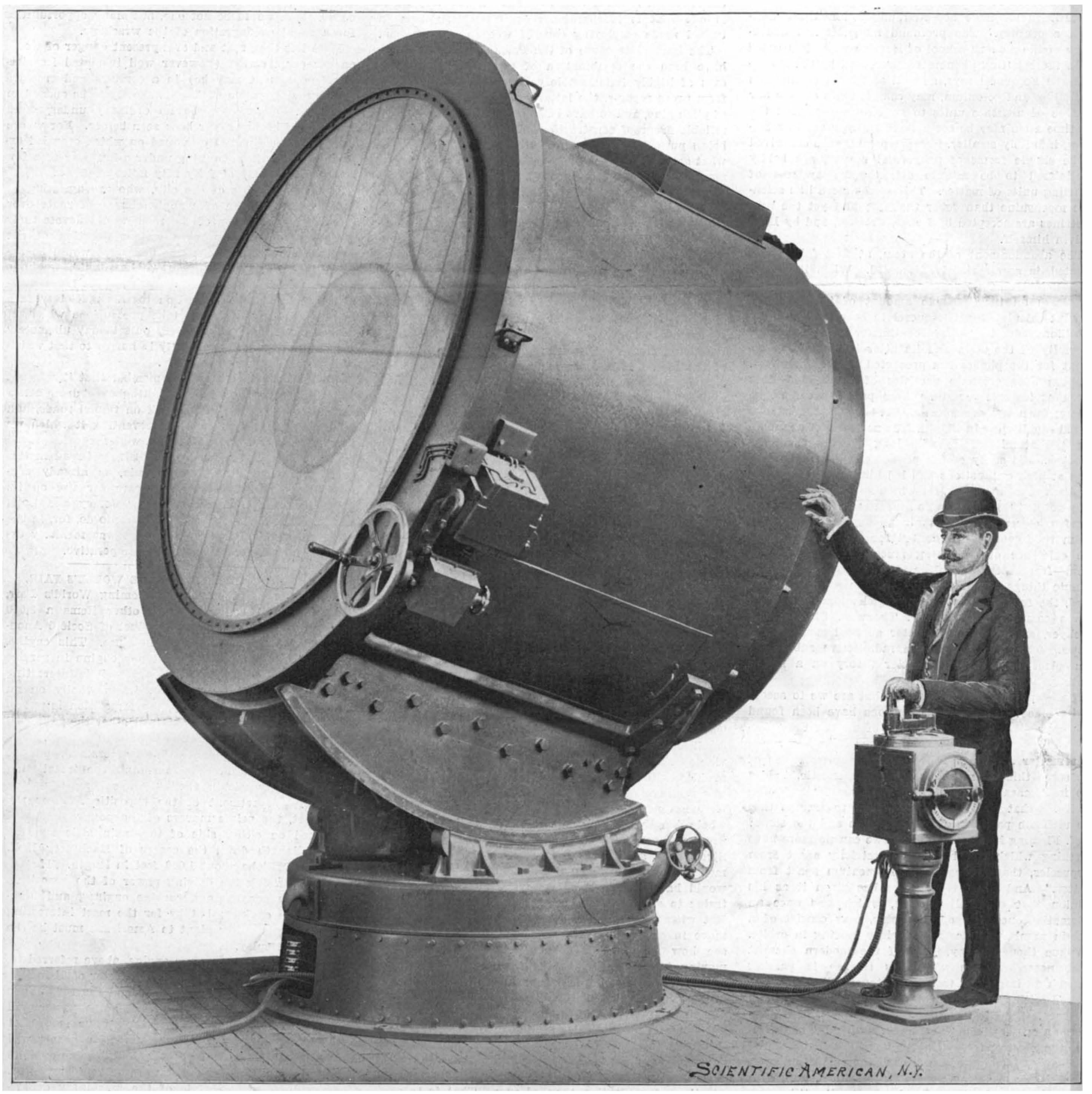
The three searchlights mounted on the lower revolving platform 120 degrees apart have mirrors 29 inches in diameter and utilize a direct current of 34 amperes each, the platform revolving at the rate of four revolutions per minute. The electrical apparatus was constructed by the Elektricitäts-Actiengesellschaft, formerly Schuckert & Co., of Nuremberg. The current is supplied to the tower lights by a lead iron-armored covered cable connected with the power station. The power plant consists of two steam engines directly connected to dynamos of 216 amperes capacity at a pressure of 75 volts.

This new electric beacon is to take the place of the old petroleum light that so long flashed out its danger signals at the mouth of the river Elbe. The new electric light is probably the most powerful at present in operation. Apart from its enormous power, the Heligoland lighthouse is noteworthy for the fact that a return has been made to the old form of parabolic mirror, with a powerful light in the focus, instead of the usual Fresnel lenses and prisms.

The mirrors of the Heligoland light consist each of a piece of silvered glass. No protection against weather is provided in front of the light, and it is asserted that none is needed. Besides the three mirrors mentioned, a fourth mirror and lamp is provided, which will turn three times as rapidly, but which, it is said, will be used only in cases of emergency.

The duration of one-tenth of a second for the flash, a characteristic of most French beacon lights, is here adopted for the first time in Germany. It is, however, a question whether these brief durations have not been

(*Continued on page 133.*)



A GREAT SEARCHLIGHT OF 316 MILLION CANDLE POWER, FITTED WITH IRIS SHUTTER. DIAMETER, 6 FEET, 6 INCHES.

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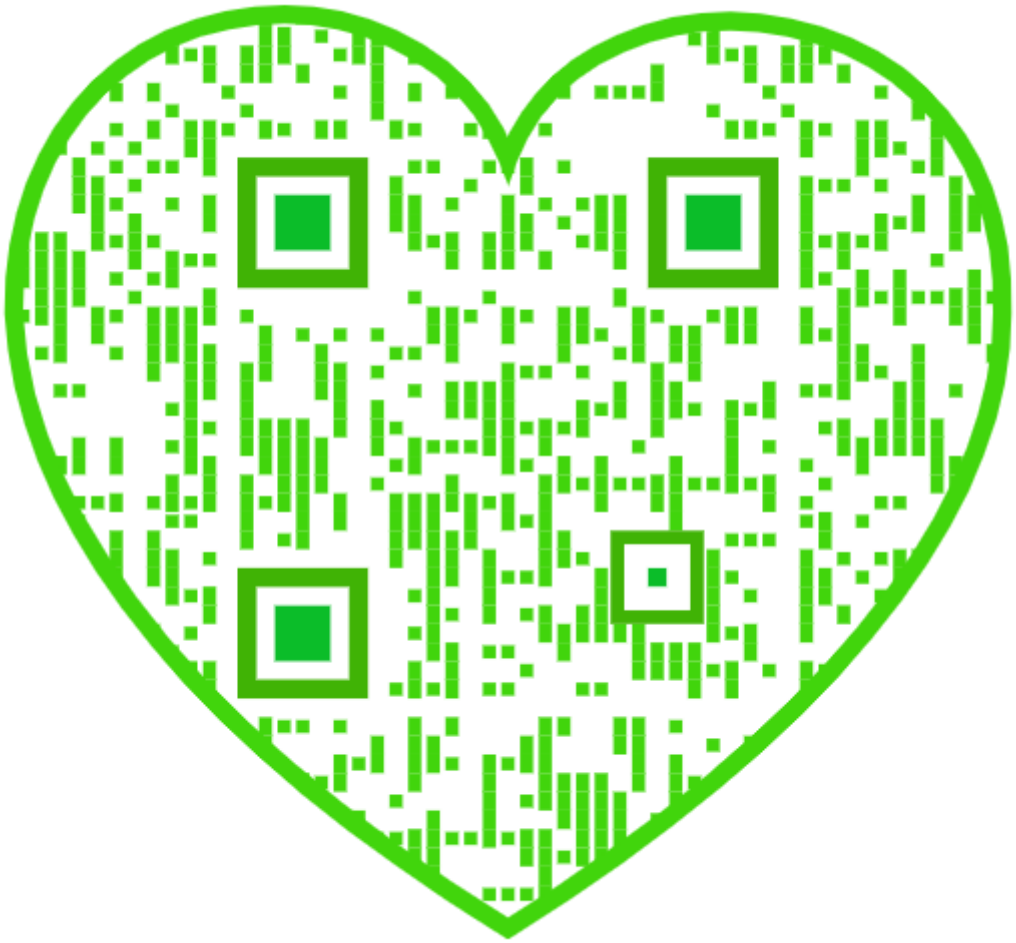

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NEW YORK, SATURDAY, AUGUST 22, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE NEW CHEMISTRY.

Just what shall be done with the newly-discovered radio-active substances is a problem that perplexes every thinking physicist. They refuse to fit into our established and harmonious chemical system; they even threaten to undermine the venerable atomic theory, which we have accepted unquestioned for well-nigh a century. The profound mathematical deductions of the modern school of English physicists, based upon the startling phenomena presented by the Roentgen and Becquerel rays, as well as by the emanations of radium and polonium, may compel us to change our notions of ultimate units to such an extent that the old-time atom may be compelled to give place to something infinitely smaller. The elements, once conceived to be simple forms of primordial matter, are boldly proclaimed to be minute astronomical systems of whirling units of matter. This seems more like scientific moonshine than sober thought; and yet the new doctrines are accepted by Lodge, Crookes, and by Lord Kelvin himself.

The abandonment of the atom, at first faintly advocated, is now seriously discussed. When it is considered that radium, despite its prodigious radio-activity, loses an inappreciable amount of its mass—an amount calculated by Becquerel to be one gramme in a billion years per square centimeter of surface—the enormity of the atom and its utter inadequacy to account for the phenomena presented become manifest. Radium does emanate particles of some kind—this much at least is certain. These particles cannot be atoms; for atoms are so large that the active substance would rapidly lose in weight. The necessity of abandoning the atomic theory was long ago discussed by Crookes. His study of the phenomena of the vacuum tube at high exhaustions had led him to formulate his "radiant matter" theory, for which he was compelled to bear not a little ridicule. To him it seemed that the luminous, electric, or mechanic phenomena of the vacuum tube could be accounted for only by assuming the existence of something much smaller than the atom—fragments of matter, ultra-atomic corpuscles, minute things very much lighter than atoms, and indeed, the foundation stones of which atoms are themselves composed. Prof. J. J. Thomson, Sir Norman Lockyer, and Lord Kelvin later adopted some of his views. The discovery of the radio-active substances has placed the radiant matter theory on a firmer footing.

If we must discard the atom, what are we to accept in its place? Two new conceptions have been found necessary—the "ion" as the unit of matter, the "electron" as the unit of force. The new chemistry holds that matter and force are different manifestations of the same thing. Inertia is the characteristic, indeed the indispensable, property of both matter and electricity. What could be simpler than to assume that the ultimate particles of each are one and the same? Prof. Fleming has declared that "we can no more have anything which can be called electricity apart from corpuscles, than we can have momentum apart from matter." And Sir Oliver Lodge has given it as his opinion that the Dalton atom, which was once an axiomatic conception of chemistry, may consist of a certain number of electrons rapidly moving in orbits.

Vague though many ideas of the modern chemist must necessarily be when his science is passing through an important transition stage, still he has calculated with no little nicety the masses of ions and electrons. Sir Oliver Lodge puts it thus: If we imagine an ordinary-sized church to be an atom of hydrogen, the electrons constituting it will be represented by about 700 grains of sand, each the size of an ordinary full stop, rotating, according to Lord Kelvin, with inconceivable velocity. Crookes puts it still more graphically. The sun's diameter is about one and a half million kilometers, and that of the smallest planetoid about twenty-four kilometers. If an atom of hydrogen be magnified to the size of the sun, an electron will be about two-thirds the diameter of the planetoid.

If the electrons of all elements are exactly alike, or in other words, if there is but one matter, just as there is but one force, and if the elements be but the various manifestations of that one matter, due to a different orbital arrangement of electrons, it would seem that we are fast returning to the conceptions of the middle-age alchemist. The transmutation of metals involves but the modification of the arrangement of electrons.

Many an old chemist looks askance at these modern views on matter. Few indeed venture to accept them without qualification. Of one thing at least we are certain—the atomic theory, if it is not a theory of the past, must be satisfactorily modified to account for the phenomena of radio-activity.

FIRE PERIL ON UNDERGROUND RAILROADS.

We have no wish to play the rôle of alarmist; but in the presence of the recent railroad tragedy in Paris, in which nearly a hundred people were smothered like rats in a hole, it is scarcely possible to exaggerate the risks which may attend the operation of electrically-driven cars in a subway or deep-tunnel road. While it is true that there were conditions peculiar to this French railroad that contributed to the swiftness and thoroughness of the disaster, conditions which are not present in our own New York subway, the fact still remains that the chief contributory cause is one that is inseparable from electrically-operated tunnel roads employing cars of wooden construction.

The immediate cause of the Paris disaster seems to have been the combination of poor insulation with cars of highly inflammable construction, for, judging from press reports, the latter seem to have been built of pitch pine, and to have embodied little, if any, really reliable fireproof construction. The burning cars were being pushed ahead by the following train, when by what seems to have been a piece of inconceivable mismanagement, two other loaded trains were permitted to run up close to the burning train ahead of them. In the height of the confusion the lighting system in the tunnel broke down, and the passengers found themselves enveloped in utter darkness and in an ever-increasing cloud of dense and suffocating smoke. The exits from the tunnel appear to have been very limited in capacity and the struggling mass of victims was unable to find even those that existed. Hence, it was only a question of a few brief minutes before the panic-stricken mob succumbed to suffocation.

Judging from the comments of the public press and of the men who are responsible for the construction and operation of existing and proposed underground roads, both here and in Europe, the chief lessons of the disaster have been laid well to heart. It is recognized that all underground tunnels should be provided with ample and easily-reached exits; that a complete system of ventilation must be installed; and lastly, and most important of all, that the cars must be of the very best fireproof construction. As regards the 20 miles of subway that are shortly to be opened in this city, the risk of suffocation due to the burning of a train are claimed to be not so great as on the Paris subway, for the alleged reasons that, generally speaking, the subway lies very close to the surface, the stations are closer together, and that the openings from the tunnel are ample for ventilation. As a matter of fact, the provision for ventilation throughout the greater part of the road is merely that which exists at the stations, where it consists of nothing more than the stairways for the entrance and exit of passengers. It is true that along the Boulevard there are open wells, but below 42d Street the subway will have to depend upon station stairways alone for ventilation. This is to be accounted for by the fact that the crowded condition of the streets renders it undesirable to provide openings through the street surface if they can be avoided, although we have always considered that it was a grave omission that special ventilating shafts were not put in at regular intervals throughout the whole length of the road. Certain it is that if a fire should occur, say on Fourth Avenue or beneath 42d Street, the smoke and gases would have no ready means of escape from the tunnel, and dependence would have to be placed upon the movement of the trains to effect its discharge at the station openings. But when we consider that just as many trains will move in one direction as the other, it is difficult to see how the much-talked-of "piston effect" of the moving trains will clear the tunnel atmosphere by promoting a circulation of pure air. Indeed it is pretty safe to say that it will do nothing of the kind, and in the event of a fire there will be nothing for it but to close the particular section of the tunnel where it occurs to all traffic until the fire is subdued and the smoke and gases have had time to dissipate.

Evidently, then, in our own subway it is more a question of prevention than of cure. That is to say, it is absolutely imperative that the construction of the rolling stock be such that the burning of a car or train of cars will be rendered impossible. The only certain way to insure this immunity from fire is to exclude from the cars every particle of inflammable material; and this can be accomplished satisfactorily only by building them entirely of metal.

We are well aware that the management of the Interborough Railroad Company have stated that the new cars are to be very thoroughly fireproofed, and it must be admitted that on paper the precautions that are to be taken in the way of incombustible linings for the floors of the car, asbestos protection, the use of fireproof paint, etc., are among the most approved methods of protecting inflammable material. In the present case, however, the risks attendant upon the break-down of this system of fireproofing are so frightful that it should certainly be abandoned in favor of the only absolutely sure method of abolishing every particle of wood and making the cars, from trucks to ventilator, entirely of metal. We will admit that the system of insulation of the wiring and protection of the wooden floor framing of the cars as outlined by the Interborough Company will probably prove to be effective against the blowing out of a fuse, or the other break-downs incidental to an electrical installation; but in the present case we have to provide against the extraordinary risks of fire, such as would occur in the smash-up of a collision. It can readily be seen that in a bad train wreck, whether by collision or derailment, these elaborate fireproof precautions might lose all their value, and in the rupture of the wires and the short-circuiting and arcing that would probably occur, there would be not one, but many opportunities for a rapid conflagration of the wreckage.

Here lies the great and ever-present danger of wooden car construction (however well insulated its electrical equipment may be) in a confined and crowded underground system such as is shortly to be opened in this city. Ours is to be no ordinary underground road. Its like has never been seen before. For where can we find a parallel to a road on which crowded express trains will be running under a headway of a few minutes at speeds of fully fifty miles an hour?

If the merchants of the city, who are agitating so volubly the question of a slight change of route over a single short section of the road, would devote their attention to this far more serious question of the safety of the road itself, their energies would be applied to better purpose. As we have said, we have no wish to play the rôle of alarmist, and we are satisfied that in drawing attention to this matter we are merely urging the city to take precautions which, if they are not taken at the very outset, may ultimately result in a disaster second only in horror to that which has recently occurred in Paris.

Many of our readers will remember that it was not very long ago that George Westinghouse drew attention to this question of fire risk on tunnel roads, and advocated the very means of preventing it which we now urge. That the point was well made is proved by the fact that the most progressive railroad in this country, namely, the Pennsylvania, is already constructing experimental all-steel cars for use on its great tunnel system between New Jersey and Long Island. It is obviously the only thing to do, for, in the presence of this Paris horror, what was formerly expedient now becomes absolutely imperative.

FOREIGN GAS ENGINES AT THE WORLD'S FAIR.

The power plant of the forthcoming World's Fair, St. Louis, will contain among other items a 3,000 horse power gas engine, the product of Société Anonyme John Cockerill, Seraing, Belgium. This engine, we believe, will be the largest gas engine in service up to the time of its installation, and it is interesting to note that it will go to St. Louis wholly on an exhibit basis; that is to say, the Exposition is put to no expense for the power obtained other than the cost of transportation, installation, and maintenance. The World's Fair power plant will, we understand, embrace more than 40,000 horse power, and the installation will be wholly within the buildings comprising the machinery department of the exposition. For the most part, the prime movers of the power plant will be placed on either side of the main aisle running the full length down the center of Machinery Hall. This aisle will be about 1,000 feet in length. The engines comprising the driving power of the exposition will include gas engines, turbine engines, and high-speed steam engines; but by far the most interesting feature of this power plant to Americans must be the gas engine display.

The 3,000 horse power gas engine, above referred to, has two cylinders, each having a diameter of 51 inches. The length of stroke is 55 inches and the revolutions per minute when developing 3,000 horse power will be 85. The length over all of the engine is 67 feet 1 3-8 inches. The bed-plate or foundation proper will have a length of 77 feet, 6 inches. The foreign exhibits for the St. Louis power plant were gathered by Lieut. Godfrey L. Carden, R.C.S., of the machinery department of the exposition, who was detailed by the Sec-

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retary of the Treasury for service at St. Louis. He has been engaged for nearly nine months in Europe in collecting late-type units for the machinery department, and more power, we learn, was turned in by foreign manufacturers than could be used at St. Louis.

While the John Cockerill Gas Engine will represent the largest gas engine in service up to the spring of 1904, Lieut. Carden informs us that when he was at the works of the Gasmotorenfabrik-Deutz, Deutz near Cologne, Germany, he found that that establishment was engaged in completing designs for a 6,000-horse power gas engine, and that the statement was made to him that by 1905 gas engines of this unprecedented size would be put on the market. When one considers the relatively small units in which gas engines are built in America, the advanced stage of the gas engine industry in Europe must be at once apparent. In addition to the John Cockerill engine there was secured a 1,600-horse power gas engine of the Oechelhauser type, the product of the house of A. Borsig, of Tegel, near Berlin. The Borsig engine will be attached to a Crocker-Wheeler electric generator, and the gas producer will come from the German house of Julius Pintsch, of Berlin. The Pintsch gas producer will have a capacity sufficient for developing 2,400 engine horse power. The total weight of the shipment from Tegel will approximate 660 tons.

A 1,800-horse power gas engine of the Nuremberg type will also be put in service at St. Louis. The drawings of this engine show a length over all of 60 feet and a breadth between extremes of 19 feet 4 inches. The flywheel will measure 18 feet, and at 1,800 horse power the number of revolutions will be 92 per minute. Large as this flywheel is, it will be exceeded by that of the John Cockerill engine, which will be 26 feet 3 inches in diameter.

Aside from the gas engines displayed at St. Louis the exhibit of high-speed steam engines is bound to attract great interest, for it must be admitted that in the matter of high-speed engines of large powers, we have not made so much progress as foreign manufacturers. The house of Delaunay-Belleville, of Saint Denis (sur Seine), France, will send to St. Louis a complete unit of 1,500 horse power, embracing a high-speed vertical triple-expansion engine, with boilers and generator complete. This engine will operate ordinarily at 325 revolutions per minute. Another high-speed engine is a 1,200-horse power unit of the Williams & Robinson, Rugby, England, type. Among the famous foreign engine builders who have made offerings for the St. Louis power plant are Franco Tosi, of Legnano, Italy, a 2,500-horse power steam engine; Carels Frères, Ghent, Belgium, a 2,500-horse power steam engine; Augsburg-Nuremburg, Nuremburg, Germany, a 2,500-horse power, vertical triple-expansion engine; Greenwood & Batley, Leeds, England, a 300-horse power turbine engine; Société Alsatienne de Constructions Mécaniques, Milhausen, Germany, a 1,000 horse power tandem engine with direct-connected dynamo.

The Machinery Hall of the St. Louis Exposition is already applied for several times over, and with the great power plant, aggregating 40,000 horse power, installed in the center of this building, there is every reason to believe that the machinery display at St. Louis will exceed in completeness, extent and in the up-to-date features presented, anything of the kind in the way of a machinery exhibit the world has ever seen.

THE MANDATORY BLUE PRINT.

BY EGBERT P. WATSON.

From some experiences of my own and cases where I have been called in, I am led to believe that departures from the absolute readings of blue prints are quite common. That is to say, persons who undertake to construct machines or apparatus of all kinds from them permit themselves to act as judges as to whether the proportions laid down are correct or not, and whether other forms than those shown would not be better. If the designer of the machine were consulted previously concerning the proposed changes there would be no harm done, for he would have an opportunity to decide whether the so-called improvements were such in fact, or only mere impertinences upon the part of those who suggested them. In one case an inventor had designed a machine which had a peculiarly appropriate movement which he had covered in his patent claim; when he examined his machine he found that this had been disapproved of by some one connected with the works, and a monstrosity of their own devising inserted in its place. As a consequence, he rejected the machine, and demanded that his device be put in its place; the constructors refused to do this, for the machine would have to be practically rebuilt to get it in, and suit was brought to recover, the result being that the builders had to pay heavy damages and costs.

It is important that all persons accepting blue prints as guides to work from should bear in mind that they have no responsibility whatever if they reproduce line for line and figure for figure, and adhere closely to the dimensions; failing this, they assume all the liabilities of the slightest omission or change, no matter whether the same is an improvement or the reverse. Under some interpretation of shop ethics, it is supposed to be a "neighborly" proceeding to make changes and alterations without consultation. After an exhibition of such "neighborliness" a constructor recently said to his customer: "Your machine is all right now; we had to go all over it, for it wouldn't have worked the way you had it"; and great were his surprise and chagrin on learning that several machines were already at work upon the identical plans he had condemned as impracticable. As in the previous case mentioned, the contracting party refused to accept the job.

It has been decided by the courts that the acceptance of a blue print from contracting parties is in itself a guarantee that the machine constructed from it shall be an exact duplicate in metal or other material, and no explanations as to failure to follow the print will absolve the contractor from neglect to perform his part of the agreement. In plain words, a blue print is mandatory.

Within a very short time I have been asked to compare the work upon a certain boiler with the blue prints furnished by the contracting parties. The departures from it found were many, the curious part of the execution of the work being that the changes made were of no pecuniary benefit to the boiler makers. In one case a pipe was inserted which was one inch diameter only, the drawing calling for one and a quarter inches; the contractor decided that this last was too large, and made the change without consulting the owners. Consultation is always necessary in constructing work where changes that are imperative have been overlooked by the designer, for the most expert men are not infallible. Clerical errors, also, are not unknown, where different dimensions are put on detail sheets for the same members. When a difficulty of this class is encountered, the duty of a contractor is to ascertain which is the right one before proceeding with the work. A word as to the procedure with blue prints may not be amiss. How many are there who sit down to inspect them carefully—peruse them is a better word—before handing them to a subordinate to execute? The number of such persons is fewer than might be supposed. A common practice is to send them directly to the shops, but before this is done the chief draftsman should have his will of them, where no one can molest or make him afraid; for, be it known, the average blue print is far from perfect in its entirety. Scale drawings are a necessity to give an adequate idea of the finished machine, and the relations of parts one to another, but no man can work from an unmarked scale drawing, because the truth is not in it. The great printer, the sun, has looked askance at it, and the measurements, or the scale sizes, are distorted amazingly. There is no size on it which can be trusted to measure from and reproduce in metal; the draftsman who made it is human and prone to err. Nothing but the absolute figures is reliable, and of these there is an alarming scarcity in some drawings. For these and for other considerations, before construction is commenced, all blue prints should be carefully studied by an expert.

N-RAYS DISCOVERED BY M. BLONDLOT.

In a recent issue an account has been given of the new form of radiation discovered by M. Blondlot. He finds, in fact, that most of the artificial sources of light and heat emit radiations which are capable of traversing metals and a great number of bodies which are opaque for the ordinary rays of the spectrum. In a paper read before the Académie des Sciences he describes some later researches upon this new form of radiation. The rays were first discovered by using a Welsbach burner, but he wished to see whether they are given off from other sources. A circular gas flame emits them, but the chimney must be removed on account of the absorption of the glass. A Bunsen burner does not appreciably produce them, but a piece of sheet iron or a silver plate heated with a Bunsen burner behind it will give off the rays almost as well as a Welsbach burner. A plate of polished silver inclined at 45 degrees and heated to a cherry red by a Bunsen burner was found to emit rays which are quite analogous to the former. A horizontal beam of this radiation, after passing through two sheets of aluminium or a total of .01 inch, as well as black paper, etc., was concentrated by a quartz lens. By using a small electric spark as an explorer, as before, the existence of four focal regions is shown. He also finds that the action on the spark is much greater when it is placed vertically or in the plane of the emission, than when it is perpendicular to this plane. This shows that the rays coming from the plate are polarized, as are those of the light and heat which it emits at the same time. When the plate is covered with lampblack the intensity of emission is increased, but now the polarization disappears. M. Blondlot uses the term N-rays* to designate the new radiation. He remarks that they include a great variety of radiations; in some cases the index of refraction is greater than 2 and from other sources it is below 1.5. Up to the present a spark is used as a detector, but if considered only as incandescent gas, the spark should be replaced by a flame. He used a small flame formed at the end of a metal tube with a fine bore. This flame, which is entirely blue, can be used instead of the spark, and, like it, when it receives the rays becomes whiter and more luminous. By the variations in brightness he finds four foci in the beam traversing a quartz lens, the same as with the spark. He also finds a new effect of the N-rays. They are incapable of exciting phosphorescence in bodies which acquire it by the action of light, but when such a body, for instance sulphide of calcium, has been previously exposed to the sun and rendered phosphorescent, if now it is exposed to the N-rays (especially at the focus through a quartz lens) the phosphorescence is seen to increase in brightness considerably. This phenomenon is one of the easiest to observe in the case of the N-rays. This property is analogous to that of red or infra-red rays as noted by M. Becquerel and also analogous to the action of heat on phosphorus. It seems certain that the new rays have points in common with the known rays of great wave length. On the other hand, the property which they have of traversing metals differentiates them from all others known. It is very probable that they are to be found among the fine octaves of the series of radiations which remain unexplored between the Rubens rays and the shortest electro-magnetic waves, and this he proposes to verify.

In another series of researches he finds that the new rays are given off by the sun. A chamber which is completely closed and dark has a window exposed to the sun, and closed by thick interior shutters of ⅝-inch oak wood. Behind one of the panels at 3 feet distance is placed a tube of thin glass containing phosphorescent sulphide of calcium which has already been slightly exposed to the sun. If in the path of the rays from the sun which are supposed to reach the tube through the wood, a lead plate or simply the hand be interposed, even at a great distance from the tube, the brightness of the phosphorescence is seen to diminish. When the screen is removed the brightness is restored. The great simplicity of the experiment makes it easy to repeat; the only precaution to take is to operate with a low initial degree of phosphorescence. The variations of brightness are especially easy to observe at the contours of the luminous spot which is formed by the phosphorescent body against a dark background. When the N-rays are cut off these contours lose their sharpness, but resume it when the screen is removed. These variations do not seem to be instantaneous, however. The phenomenon still takes place when several plates of aluminium, cardboard, or an oak plank 1 inch thick are placed in the path of the rays. All possibility of the action of radiant heat properly so-called is therefore excluded. A thin layer of water is found to stop the rays entirely, and even light clouds passing over the sun diminish the action considerably. The N-rays which are given off by the sun can be concentrated by a quartz lens, and with the phosphorescent body as a detector he observes the existence of several foci, but expects later on to determine their position more accurately. The rays undergo a regular reflection from a plate of polished glass, and are diffused by ground glass. In the same way as the N-rays which are given off by a Crookes tube, flame, or incandescent body, those given off by the sun act on the small spark or flame and increase its brightness.

*From the University of Nancy, where most of the experiments were made.

LANGLEY'S AERODROME EXPERIMENTS.

Prof. Langley's 12-foot aerodrome was tested on August 8, with results considered decidedly encouraging by its inventor. The model flew a distance of 600 yards and then sank in 22 feet of water. When it was finally recovered, all that was left was a tangled wreck of twisted wires. The time consumed in flight was not more than 45 seconds. The course described was a semi-circle. According to accounts which have been published, the motor of the machine and the rudders failed to work properly. The altitude of the machine at the time of the fall was not greater than 50 feet. From the meager reports which are thus far available, it seems that the airship was driven by an 8 horse power hydrocarbon engine connected up with two two-bladed propellers located one on each side of the machine at about its middle point. One four-bladed wind vane rudder was mounted behind the engine; then came the rudder proper. On each side the airship was supported by a pair of white silk wings, 4½ feet long by 2 feet in width. The propellers were located on the side between the wings and turned toward each other. The wings, rudders, engine and other running gear were fastened to a central cylindrical tube of aluminium 18 inches in length and about 4 inches in diameter and tapering at both ends. It is said that the test of the small model will be followed at an early date by a trial by the 60-foot aerodrome which is owned by the government, and which cost $70,000.

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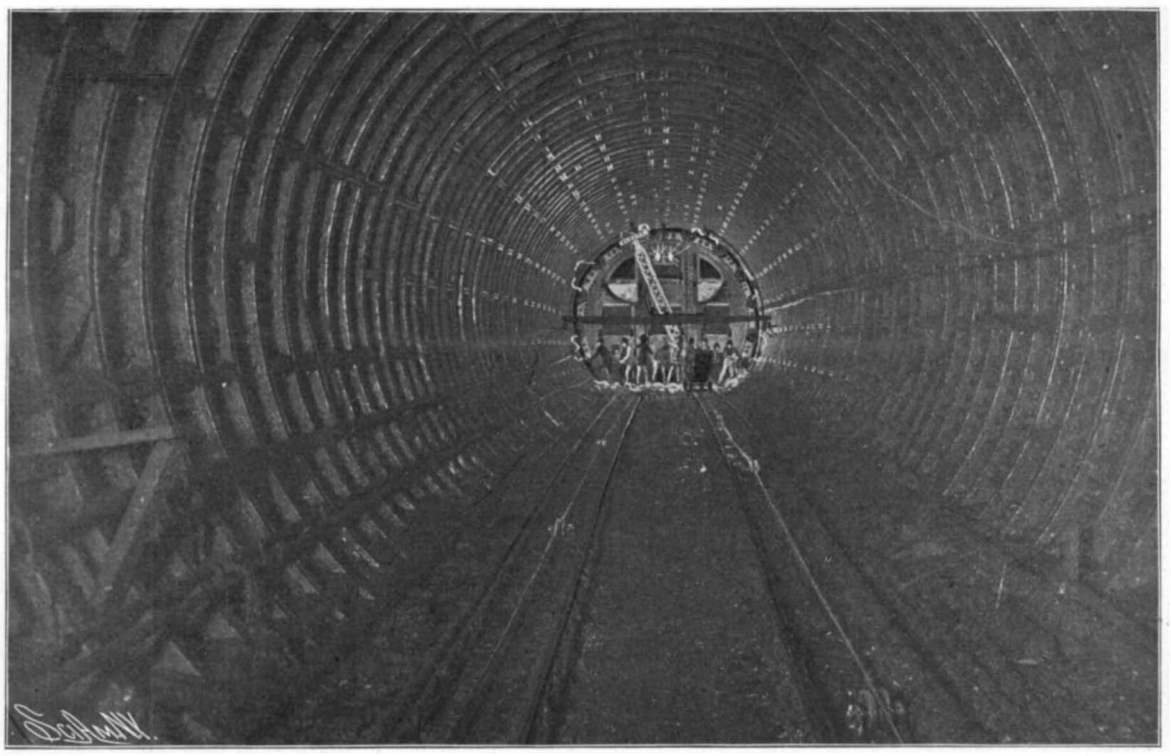
THE HUDSON RIVER TUNNEL.

The work of driving the Hudson River tunnel from Jersey City to Manhattan has progressed so favorably under its present management, that before very long communication beneath the river will be established. The tunnel will provide communication between the trolley systems of New York and Jersey City, and by affording a rapid and continuous service between these cities, will confer a great boon upon the traveling public who hitherto have been restricted to an intermittent ferry service. The original projector of the Hudson River tunnel was Mr. Dewitt Clinton Haskin, one of the active spirits in the building of the Union Pacific Railway, who commenced the construction of the tunnel as far back as 1874. The original plan called for two separate tunnels with a single steam railroad track laid in each. A circular working shaft 30 feet in diameter was dug on Fifteenth Street, Jersey City, 100 feet inside the bulkhead line of the river; it terminated in an enlarged chamber from which the headings of the two parallel tunnels were started on an easy grade toward their deepest level, which lies in the proximity of the Manhattan shore. The New York shaft was sunk near the bulkhead line at the foot of Morton Street, the distance between the two shafts being about 5,400 feet. Mr. Haskin commenced the construction of the tunnel without the use of the customary excavating shield and iron lining, relying upon the compactness of the silt through which the tunnel was driven to prove sufficient, in co-operation with the compressed air, to resist distortion until the 2-foot brick lining of the tunnel could be built in place.

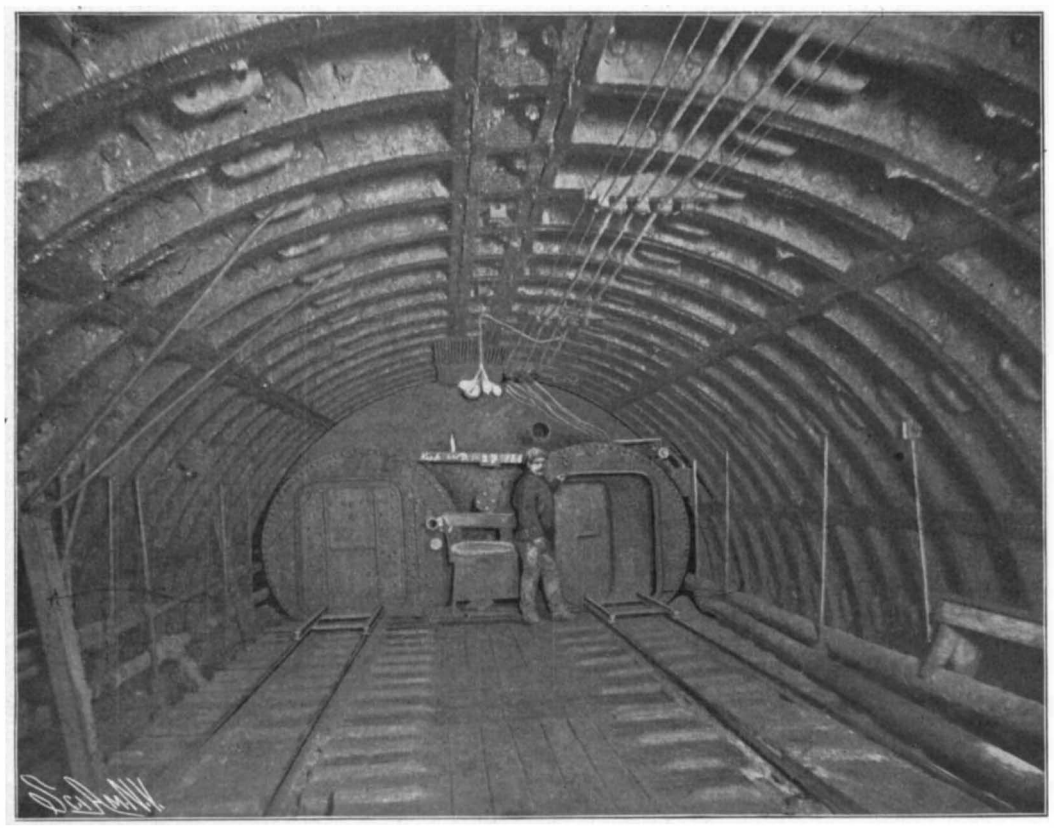


View in Rear of Shield at Heading, Showing Full Diameter of Tunnel (19 Feet 4 Inches).

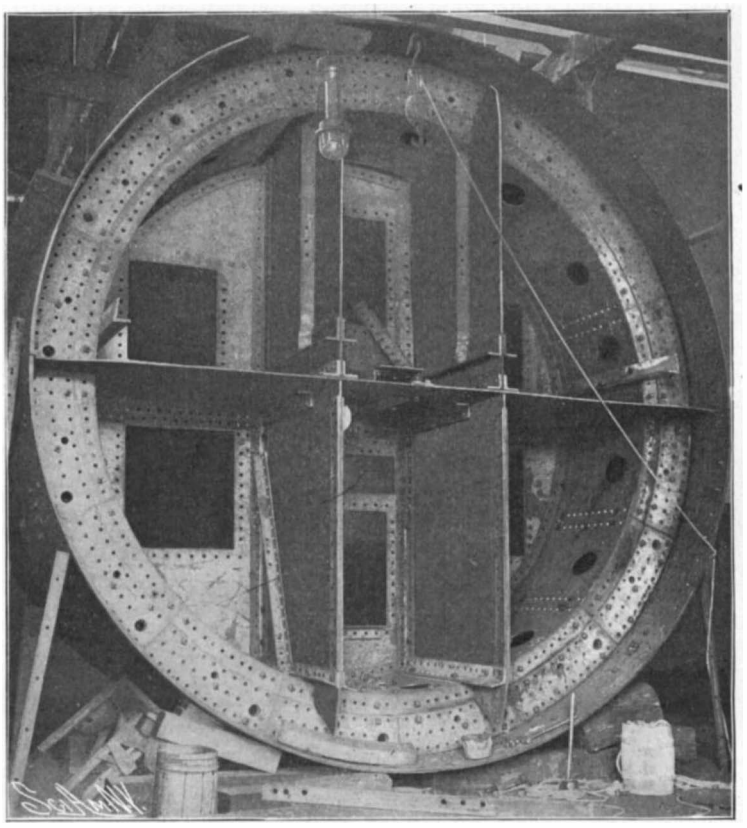
The difficulty of closing air leaks with sufficient alacrity led to the use of a pilot tunnel at the heading. This consisted of a 5-foot iron tube which was carried forward on the line of the axis of the tunnel into the ground ahead. This tube was used as a center from which braces were carried out radially to hold the surrounding wall of the tunnel during construction. On July 21, 1880, a shocking accident occured, due to the shallowness of the overlying silt above the tunnel roof. There was a blow-out which resulted in such a sudden in-rush of water that the air lock became jammed, and twenty of the workmen were caught and perished. The work was carried on with more or less intermission until, with 2,000 feet of the north tunnel completed, the company in 1882 suspended operations. Subsequently, in 1890, an English company was formed with Sir John Fowler and Sir Benjamin Baker as consulting engineers, for the purpose of completing the tunnel; but after carrying the tunnel forward until 3,895 feet was completed, they also abandoned the work. Ultimately the New York and New Jersey Railway Company was incorporated for the purpose of carrying through the great undertaking, and they have prosecuted it with such vigor that the north tunnel will probably be completed in January, 1904.

The tunnel descends from the Jersey side on a grade of about two per cent, and at a depth below the river bottom which varies from 5 feet to over 60 feet. The shaft already referred to at the western end of the tunnel is 30 feet in diameter and 65 feet in depth. It is brick-lined and opens into the power house in which the new operating plant has been installed. The external diameter of the northern tunnel is 19 feet 5¼ inches and its internal diameter 18 feet 1¼ inches. The southern tunnel, which is being built of a diameter to accommodate the trolley cars which it is now intended to run through the tunnels, is 15 feet 3 inches in internal diameter, and 16 feet 7 inches in external diameter.

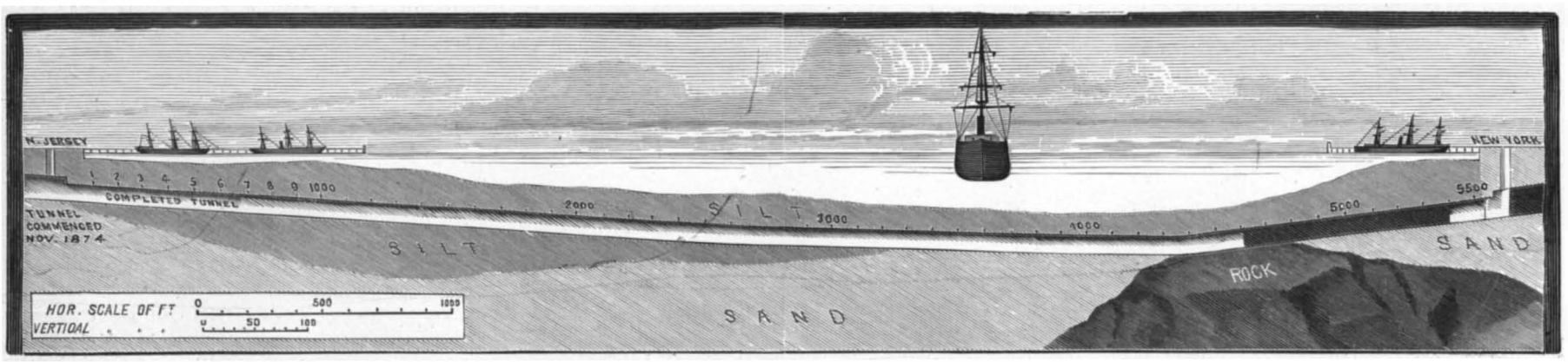
Both tunnels are being built by the Greathead shield system and lined with a cast-iron shell which is made in segments provided with internal flanges by which the shell is bolted in place. It is interesting here to recall the fact that the first use of the system of tunneling now known as the Greathead system ever made in this country occurred in the construction of a short section of the projected Broadway underground railway in this city, when the method designed by the late Alfred E. Beach, one of the editors and proprietors of this journal, was successfully used.



View of Twin Air-lock in Tunnel, Showing Shifting Rails for Entering Lock Chamber.



Front View of New Shield for South Tunnel.



Profile of the Hudson River Tunnel, Showing by Black Shading the Portions Yet to be Excavated.

THE HUDSON RIVER TUNNEL.

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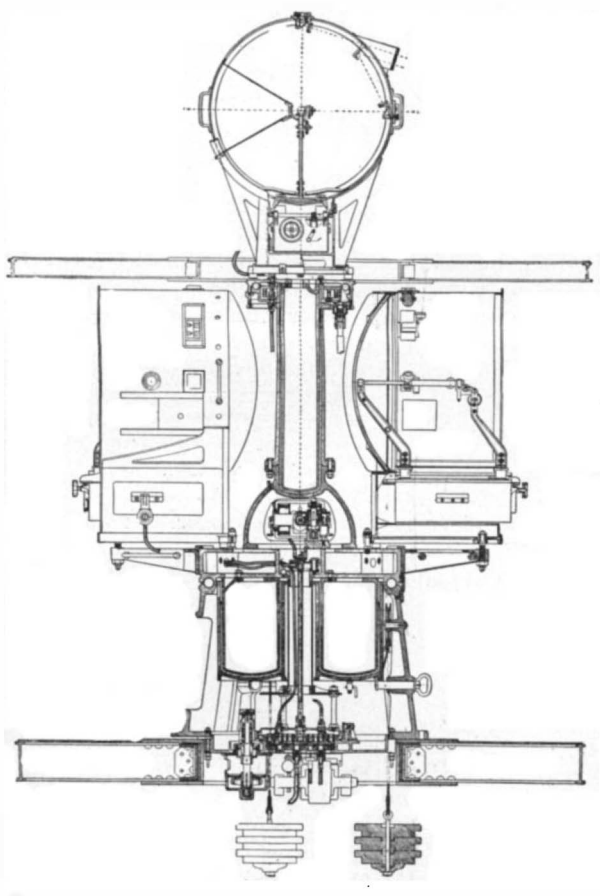
After the English company abandoned the construction of the northern tunnel in 1891, it was allowed to fill with water. When the work was taken in hand by the present company the tunnel was pumped out, and it was found that with the exception of some 470 feet, the work already done was in good condition. This was in the latter part of 1896, and from that time until 1902, when orders were given to proceed with construction, the tunnel was regularly pumped out and maintained in good condition. A new building was erected at the Jersey shaft, equipped with a very complete power plant, including hydraulic pumps and air compressors, etc. The shield which was used by the English company was overhauled and is being used in completing the north tunnel. It was designed for use only in silt, and as the tunnel has now reached a point where rock and boulders are encountered in the lower half of the excavation, it has been found necessary to build a heavy apron, extending 6 feet in advance of the upper half of the cutting edge of the shield, and reaching from side to side of the shield. This apron is built of 12-inch I-beams and ¾-inch steel plates, and it is strongly braced. Under the shelter of this apron, which is heavily shored up, the workmen are able to pass forward of the shield and drill and blast out the rock below it. This work is unique in horizontal shield excavation, and so far it has been carried forward with complete success.

The method of operating the hydraulic shield is so well known as to need no detailed description here. It is forced forward into the silt by means of hydraulic rams which are set up between the front edge of the completed iron lining of the tunnel and the rear edge of the shield. As it moves forward, the silt is squeezed through open inlets into the interior of the shield, where it is broken off, loaded into trucks, and drawn away from the heading by a cable. The finished tunnel is divided into three lengths by two air locks, one of which is shown in our accompanying engraving. It should be explained that the lower half of the tunnel, at the point where our picture is taken, was filled with excavated material from the heading, on which the two tracks are laid. Ultimately this material will be taken out and the full diameter of the tunnel exposed. In our engraving the two trolley tracks are clearly shown, together with the doors by which the cars pass through the air-tight diaphragm. Another of our engravings was made from a photograph taken in the rear of the shield at the present heading. In this case the material has been entirely removed, showing the full diameter. The two tracks shown are merely narrow-gage working tracks for the contractors. Ultimately, of course, a single track will be laid for the operation of trolley cars. The cable-hauling system is built in three sections, separated by the two air-locks. The first of these, which is 1,575 feet in length, extends from the Jersey shaft to the first air-lock; the second, 1,660 feet long, extends from the first to the second air-lock, while the third section reaches from the second air-lock to the working face. The cables are driven at a speed of 300 feet a minute and are capable of handling 300 tons of excavated material in every ten hours. One of our engravings represents a profile taken across the North River in the plan of the north tunnel. The completed portion of the tunnel is shown by light shading, while the darker shading shows the amount, about 800 feet, that has yet to be excavated.

TRUNKS AND LIMBS OF TREES GNAWED BY BEAVERS.

On the south tunnel new air-locks have been installed, the necessary machinery is being built, and it is probable that the actual construction of the tunnel will be taken up again in the fall of the present year. The shield for this work, which was designed by Jacobs & Davies, engineers of the company, is shown in the accompanying engraving. It will be seen that it is divided by one horizontal and two vertical frames and by transverse diaphragms. The shell is double and the whole construction is calculated to give great stiffness and resistance to distortion. It is provided in front with a movable working platform which, if necessary, may be carried forward of the cutting edge. In the rear it is provided with the necessary hydraulic jacks, valves, etc., for carrying forward the shield and for swinging the erector—a massive arm which moves something like the hands of a clock, and is used for picking up the cast-iron plates and placing them in position ready for bolting up. It is interesting to know that in spite of the difficult nature of the material through which the tunnel is now being driven, there being rock below and soft silt in the upper half of the tunnel, progress is being made at the rate of between 4 and 5 feet a day. The work is rendered particularly hazardous by the fact that there is a hydraulic head due to 65 feet of water, and that there is only 10 feet of soft silt between this hydraulic pressure and the roof of the tunnel. The successful financing of the company was completed through the efforts of Mr. William G. McAdoo, the president, associated with a few trolley capitalists, and to him we are indebted for the facts given.



SECTIONAL VIEW OF HELIGOLAND LIGHTHOUSE PROJECTORS.

MODERN SEARCHLIGHTS.

BY FRANK C. PERKINS.

(*Continued from first page.*)

carried to an extreme. Undoubtedly one-tenth of a second is sufficient to make the maximum impression on the eye, when the light is brilliant. But with a hazy atmosphere, and the light much diminished, it is doubtful whether a longer duration should not be allowed. The experiment will be watched with great interest, both on account of the bold deviation from the ordinary plan which has been so long followed, and also on the ground of economy, which is claimed for the new method. It is stated that on the first night of trial the light was seen at the pier at Büsum, a distance of 40 miles, which in itself seems sufficient to clear away all doubts of the visibility of a flash of short duration.

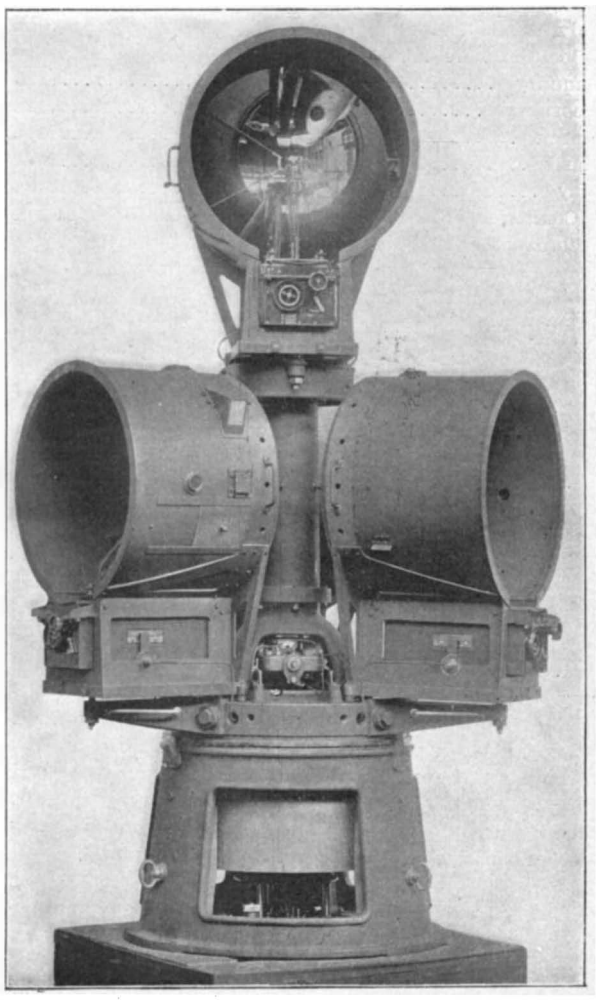
The front-page illustration shows a Schuckert searchlight with an Iris shutter, half closed, which has a diameter of 6 feet 6 inches and throws a beam of light of 316 million candle power. This search light is electrically controlled by two levers, one of which controls the motor mounted in the base of the searchlight which operates the projector in a vertical direction through a train of gears, and the other starts or stops the electric motor which controls the horizontal movement of the beam of light. The Iris shutter is used in order to make the projector perfectly light-tight at any moment desired, and it operates similarly to this type of shutter as applied to modern cameras. The leaves of the Iris diaphragm slide within a fixed diaphragm located in the axis of the ray of light and provided with a fold. On some of the German searchlights an apparatus known as a "double disperser" is provided, in order to convert concentrated light rapidly into diffused light. This arrangement consists of two parallel systems of cylindrical lenses, which may be slid against one another, whereby the angle of dispersion of the emitted ray can be varied at will. By means of this apparatus the angle of dispersion of the light can be varied within limits of from 2 degrees to 45 degrees if desired.

THE BEAVER AS A DAM-BUILDER.

A remarkable beaver dam has lately been discovered near Stroudsburg, Pa. The work of the animals is so extensive that it seems almost incredible they could have built the dam in question, but this is proved by the evidence of residents of the vicinity, who are strictly reliable.

The dam in question was discovered about two years ago, by a farmer living near its site. It is located in a swamp, which for many years had been drained of its surface water, except in a few spots. Noting that most of the swamp was under water, although but little rainfall had occurred, the curiosity of the farmer was aroused, and he made an investigation which led to the discovery. The dam has been constructed around the northern edge of the swamp, extending in a zigzag course, evidently to avoid obstruction, and to increase its strength. It is about 125 feet in length, and the top is wide enough for a man to walk upon, without difficulty, ranging from a foot to two feet in width. At present the top is about three inches above the surface of the pond which has been created by the dam, the water being from two to four feet deep.

The farmer who made the discovery at first thought that the work had been done by boys for sport, but noticing the footprints of animals upon the top of the structure, he followed these, and found some pieces of wood, which apparently bore the marks of an animal's teeth. The wood was taken to a naturalist who resided in the vicinity, and after careful examination the latter pronounced the marks to be from beaver



PROJECTORS OF THE HELIGOLAND LIGHTHOUSE.

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teeth. Further investigation in the vicinity showed that the animals had felled a number of trees near the dam, to use in its construction. The largest pieces yet found in it are 8 inches in diameter by actual measurement. The principal material used, besides branches and twigs, was mud, which had been deftly worked into it so solidly that a man weighing 235 pounds has walked upon the top without affecting it.

The wood which has been used includes beech, white ash, and oak. In cutting the trees, the animals worked in a circle around the trunk, making deeper indentations on the side toward the dam so that the trees would fall into the water in the proper direction. Judging by the size of the marks found, it is believed that some of the beavers are unusually large animals, but there have been only two or three seen since the dam was constructed. The discovery has aroused such interest that many naturalists have since visited the locality. Their belief is that the swamp has been "beaver ground" for many years, and that here has existed one of the very few colonies of these animals in the northern part of the country. The swamp is owned by Judge Edinger, of Stroudsburg, who has been making a study of the dam since it was located. So interested has he become that he will allow no one to attempt to trap or shoot the animals, and, with the aid of the Zoological Society of Philadelphia, has had a State law enacted purposely to protect them.

That Point Reyes Wind Record.

For the last two or three months, accounts have been going the round both of the daily and the technical press, in which it is stated that at Point Reyes, about 35 miles north of San Francisco, the wind recently blew continuously for three days at a rate considerably over 100 miles an hour, and that speeds up to 135 miles have been recorded. It is also asserted that for two years the Point Reyes station has taken the world's record for speed of winds.

The Scientific American has taken the trouble to investigate these statements and is informed by the Weather Bureau that there are no records of "wind velocity of 135 miles having been attained at Point Reyes." From the establishment of the station at Point Reyes Light on March 1, 1889, to the end of May, 1903, the following are the maximum velocities recorded during the several months:

January	75	July	90
February	98	August	64
March	108	September	72
April	84	October	70
May	120	November	82
June	80	December	77

During May, 1903, a very severe storm raged at Point Reyes for a number of days, and for nine consecutive days the wind blew at an average of 52 miles per hour.

Even if 135 miles an hour had been attained by the wind, at this point, still that velocity would not have broken all records in this country. We are assured by the Weather Bureau that one of its stations was in operation at Mount Washington, N. H., from June, 1871, to September, 1887, and that for three months, July, August, and September, the following maximum velocities were recorded:

January	186	July	120
February	168	August	120
March	156	September	116
April	182	October	160
May	128	December	180

Compared with these high velocities the Point Reyes records pale into insignificance.

Death of Dr. Ludwig Mond.

Dr. Ludwig Mond, the well-known chemist, died recently in Rome. Born in Cassell, Germany, in 1839, he was educated at Marburg and Heidelberg. He emigrated to England in 1862, and there introduced his well-known process for recovering sulphur in alkali works. Eleven years later he established the largest alkali works in the world at Winnington, England. He was the inventor of a process for the manufacture of chlorine and of a method of producing gas for heating and power purposes. In last week's Supplement will be found a good description of Mond gas and its manufacture. Dr. Mond also invented a ga battery and a process of making pure nickel. The latter was based on the formation of what he called nickel carbonyl, a chemical compound which he discovered and investigated with Langer and Quincke. The Davis-Faraday research laboratory, now famous throughout the scientific world, was founded by him in 1896. Besides being a scientist of rare parts, Dr. Mond was an art lover, whose collection of early Italian masters is one of the finest in England.

The heaviest train load ever hauled by one locomotive was recently reported. A train of eighty-four loaded cars, weighing in the aggregate 4,787.5 tons, was hauled a distance of 63 miles, at the rate of 13 miles an hour.

Electrical Notes.

The production of aluminium is given in a report on aluminium and bauxite for 1902, by Dr. Joseph Struthers, issued by the United States Geological Survey. The production of aluminium in the United States during 1902 was approximately 7,300,000 pounds, as compared with 7,150,000 pounds in 1901, the sole producer being the Pittsburg Reduction Company, which has large plants in operation at Niagara Falls and at Shawinigan Falls, Quebec, Canada, and is installing a large plant on the St. Lawrence River.

The problem of smelting steel by electricity has for some time attracted the attention of inventors, and many experiments have been made to achieve the desired end. In the beginning of the year 1900 an electric steel furnace, without electrodes, was built at Gysinge, in Sweden, and its action watched with considerable curiosity as to its successful operation. After a few experiments, the first ingot was produced and the steel was found to be of an excellent quality. Thus, the problem was solved in a technical way, although considerable progress was necessary before the process could be considered a commercial success. In November, 1900, a larger furnace was built on the same lines as the first one and proved much more successful than its predecessor. In August, 1901, both furnaces were ruined by fire and the firm experimenting with them decided to build a steel works. This information comes from the Trading and Shipping Journal of Gothenburg, Sweden, and is not as complete, electrically, as might be desired. However, it is stated that in the new works a 300 horse power dynamo, direct-connected to a turbine, will furnish the current. The new furnace will hold 3,970 pounds, and its yearly output is estimated to be in the neighborhood of 1,500 tons if charged with cold, raw material. The steel made under this process is said to be of a superior quality, characterized by strength, density, uniformity, toughness and the ease with which it can be worked in cold, unhardened condition, even when containing a very high degree of carbon. Tungsten steel manufactured by this process is said to make stronger magnets than other tungsten steel and does not warp in the hardening. Microscopic experiments have shown that the electrically made steel is not different in any way from crucible steel.

Prof. McKendrick, F.R.S., has been carrying out a series of experiments with a highly sensitive galvanometer, to demonstrate electrical phenomena of muscles, nerves, and heart in certain fishes, which on account of these peculiarities are described as electric fishes. These inhabitants of the seas have the power of giving electrical shocks from specially constructed and living electrical batteries. There are in all about fifty known species of fishes that possess these electrical organs, but only the electrical properties of five or six have been studied in detail. The best known are various species of torpedo, belonging to the skate family, found in the Mediterranean and Adriatic Seas; the gymnotus, an eel found in the region of the Orinoco in South America; the malapterurus, the raash or thunderer fish, of the Arabs, a native of the Nile, the Niger, Senegal, and other African rivers, and various species of skate found in the seas around Great Britain. The electrical fishes do not belong to any one class or group—some are found in fresh water, while others inhabit the sea. They possess two distinct types of electrical organs. One closely relates in structure to muscle, as found in the torpedo, gymnotus, and skate, while the other presents more of the characters of the structure of a secreting gland, as illustrated by the electric organ of the thunderer fish. Both types are built upon a vast number of microscopical elements, each of which is supplied with a nerve fiber. These nerve fibers come from large nerves that originate in the nerve centers, brain, or spinal cord, and in these centers are found special large nerve cells, with which the nerve fibers of the electric organs are connected, and from which they spring. Yet the electricity is not generated in the electric centers, and conveyed by the electric nerves to the electric organ, but it is generated in the electric organ itself. It is only produced, however, so as to give a shock when set in action by nervous impulses transmitted to it from the electric centers by the electric nerves. According to Prof. McKendrick, there are few departments of physiological science in which can be found a more striking example of organic adaptiveness than in the construction of the electric fishes. In these animals there are specialized organs for the production of electricity on an economical basis far surpassing anything yet contrived by man. The organs are either modified muscles or modified glands, structures which in all animals manifest electrical properties. The problem, however, of the evolution of electric organs is the same as that confronting us when we trace the growth in the animal world of any organ of sense, or for that matter of any organ in the body. Whether they are merely the result of mechanical causality or otherwise, Prof. McKendrick contends is too abstruse a problem for the supply of a conclusive explanation.

Engineering Notes.

Prof. Slaby has demonstrated after exhaustive experiments that the surface of the earth plays an important part as a conductor of Hertzian waves, for which many have heretofore regarded the air as the only conductor. He constructed an artificial earth which was immunized from external influence by covering the floor of his laboratory with zinc. He then experimented with waves on the floor until his theory was proved.

A recent test of Low Moor staybolt iron, made by one of the leading American railroad companies, gave the following excellent results. Three specimens were tested and the average figures were: Tensile strength, 51,020 lbs. per square inch; elastic limit, 29,656 lbs.; elongation in 8 in., 30.58 per cent. All of the test pieces passed the hot and cold bending tests. The chemical analysis showed: Silicon, .074 per cent; phosphorus, .083 per cent; iron, 99.43 per cent; carbon and manganese, traces; sulphur, none.

Some interesting experiments have been carried out with a new monorail system devised by a French engineer, M. Devic. The inventor has built a model upon the scale of one-tenth of what the actual train is to be, and with this he has attained a speed of 13 miles an hour. The train is to be propelled by electric power, and in order that high speed may be attained, the inventor relies upon two factors—diminution of weight and a more effective grip of the driving wheels upon the single track of the railroad. The inventor claims to have designed a rail which will afford the wheels sufficient grip irrespective of the weight they may be supporting. Further experiments with a much larger model are to be carried out at Nemours to prove the utility and advantages of the system. M. Devic is sanguine of attaining a speed up to 200 miles per hour.

So much persistent effort has, in recent years, been expended in cutting down boiler and engine weights on warships—and not always for the best of the service—that to the naval engineer there must be a good deal of satisfaction in reading a recent paper presented to the Institution of Naval Architects by W. H. Whiting, Assistant Director of Naval Construction of the British Navy, dealing with "The Effect of Modern Accessories on the Size and Cost of Warships." The substance of Mr. Whiting's paper is that there are a hundred and one different ways, and many of them not very useful ways, in which the weight of a modern warship has been increased. Few of them have anything to do with the propelling power of the ship, and all of them might be carefully scrutinized and revised with the certain result of advantageously lightening the ship by a great many thousands of pounds. The fondness for unnecessarily heavy brass fittings of all kinds, for example, has often been mentioned as one of the things which might well be restricted, and while this is only a little thing in itself, it is the little things which count severely in the aggregate. Take so insignificant a matter as paint, for illustration! Mr. Whiting says that one who has not the records before him may well be incredulous at the enormous weight of paint worked into a ship. The most serious feature is that the process never ceases, and the greater the pride in the ship, the greater the tendency to sink her with white lead. He mentions a case in which there was removed from the inner surface of a portion of the crew space of a destroyer paint of a weight of over two pounds per square foot. This is, no doubt, exceptional; but it may well be questioned whether all officers realize how, by a rigid economy in paint, they may not inappreciably benefit their ship. A curious development, further, has been the desire for screw gear on board ship. Not merely in rigging, but in many fittings, such as awnings, ridge-ropes, guard-chains and ropes, and in the securing of all kinds of gear, lashings have given place to screws and slips, which not only add directly to the weight, but impose greater strains on the fittings. The screws mean bigger awnings, bigger stanchions, and so on.—Cassier's Magazine.

The Current Supplement.

The London correspondent of the Scientific American begins the current Supplement, No. 1442, with an article in which he describes the method by which London's "tubes" were constructed. Dr. Charles Minor Blackford discusses the new Cuban telegraphic service. The third installment of the article on the Schroeder contact process of sulphuric acid manufacture comes from the pen of Dr. Charles L. Reese. The recent disaster which occurred on the Paris Metropolitan Underground renders rather timely a description of the details of construction of the tunnel. "Colors for Soaps and Perfumes" is the title of an article which will probably be of interest to the manufacturing chemist. Cyril Davenport tells much that is instructive and interesting on the making of mezzotints. Among minor articles may be mentioned those which describe the arduous work of the expert train dispatcher, totemism, pearls of western Europe, underwriters' laboratories, and the cultivation of India rubber trees.

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BORELLY'S COMET.

BY MARY PROCTOR.

From the time of the first observation, Borelly's comet grew brighter very rapidly and could be easily seen with the unaided eye as early as June 30. The comet is now fading rapidly from sight, and by this time is lost in the twilight.

In the Lick Observatory Bulletin, No. 47, an ephemeris given, locating the comet on my father's Star Chart, from July 14 to September 20, makes it possible to trace the path of the comet through these points for August and September.

	Right Ascension.			Declination.
	H.	M.	S.	
August 1.5	11	43	44	+ 51° 18′.8
" 3.5	11	32	21	48° 51′.6
" 5.5	11	21	50	46° 40′.4
" 7.5	11	14	49	44° 41′.2
" 9.5	11	7	31	42° 50′.8
" 11.5	11	0	49	41° 6′.3
" 13.5	10	54	23	39° 24′.1
" 15.5	10	48	12	37° 42′.9
" 17.5	10	42	2	35° 58′.0
" 19.5	10	35	58	34° 7′.2
" 21.5	10	29	54	32° 7′.0
" 23.5	10	24	3	29° 54′.8
" 25.5	10	18	30	27° 27′.0
" 27.5	10	13	31	24° 47′.3
" 29.5	10	9	20	21° 54′.6
" 31.5	10	5	59	18° 53′.8
September 2.5	10	3	36	15° 49′.9
" 4.5	10	2	1	12° 45′.1
" 6.5	10	1	8	9° 43′.1
" 8.5	10	0	50	6° 45′.1
" 10.5	10	1	2	3° 50′.8
" 12.5	10	1	37	1° 2′.4
" 14.5	10	2	27	— 1° 42′.8
" 16.5	10	3	35	— 4° 21′.9
" 18.5	10	4	52	— 6° 58′.7
" 20.5	10	6	19	— 9° 29′.5

The path can also be traced in the maps at the end of Young's "Lessons in Astronomy," by those who have not a copy of Proctor's Star Chart.

From July 14 to 30, the comet passed from Cygnus through the constellation of Draco to Ursa Major, where it was located for a while near the bowl of the so-called Great Dipper. From July 30 to August 27 it passes from Ursa Major, through Leo Minor, and will be south of Gamma in Leo by the 27th. This is the date of its nearest approach to the sun, its perihelion distance being 31,000,000 miles. On September 2 it will be half-way between Gamma and Alpha (Regulus) in Leo, and by September 8 it will be in Sextans, an insignificant group of stars midway between the constellations of Leo and Hydra. By the 20th it will have reached Hydra, being several degrees southeast of Alphard, which marks the heart of the monster, and close to Alkes in the Crater.

It will be seen, by glancing at the map for August (Map VIII., in my father's "Half Hours With the Stars"), that as Leo sets in the northwest early in the evening, the comet is no longer visible, being below the horizon at that time. A glance at Map IV., however, will give an idea of the path of the comet, if we draw an imaginary line (indicated by a dotted line in the map) passing from Cygnus, in the upper part of the map, through Draco, Ursa Major, Leo, and ending at Alkes above Hydra.

Prof. Barnard, of the Yerkes Observatory, has made a good series of photographs of the comet, with a lens only 1½ inches diameter. This shows the comet with a tail 20 degrees long. On July 24 the tail seemed to break off some three degrees back of the head. In a photograph taken July 30, the tail appeared single.

There is nothing specially remarkable about the comet, and it has been a disappointment to those who have watched for a display. Nevertheless the head has been as bright as that of many a great comet, though the tail visually has kept faint. The nucleus has not been at all active. Everything depends upon the activity of the nucleus, as far as a display is concerned.

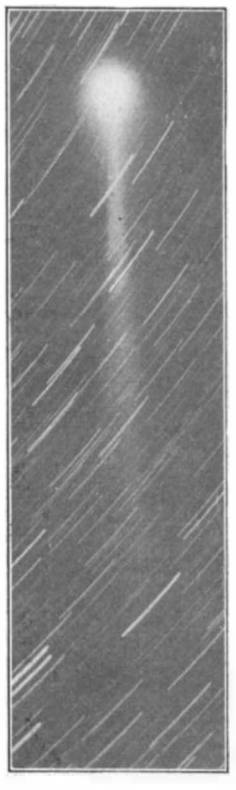
Newton's law of gravitation, which states that two bodies attract each other with a force inversely proportional to the square of the distance between them, has been made the subject of an exhaustive investigation by Prof. E. W. Brown, of Haverford College. Prof. Brown announces that his calculations show that Newton's laws represent the motion of our moon to within **one-millionth of one** per cent and that no other physical law has been expressed with anything like the precision of its simple statement.

OBSERVATIONS OF BORELLY'S COMET AT LICK OBSERVATORY.

BY W. W. CAMPBELL, DIRECTOR.

The comet discovered on June 21 by Astronomer Borelly at Marseilles, though invisible to the naked eye at time of discovery, was a conspicuous object in the evening sky in the latter half of July. The nucleus was considerably brighter than a fourth-magnitude star, and at first sight most observers would mistake it for a star. A closer examination, however, showed that it was very hazy in appearance and had a considerable diameter. In our clear skies, a tail some 4 degrees in length was visible to the naked eye. The power of the photographic plate was such that a maximum length of tail of some 10 degrees was recorded. The distance of the comet from the earth at the time was about 36 million miles, and the linear length of the tail observed was approximately six million miles.

Borelly's comet, July 15, 1903. 2 hours, 16 minutes' exposure.



Borelly's comet, July 20, 1903. Four hours' exposure.

LICK OBSERVATORY PHOTOGRAPHS OF BORELLY'S COMET.

Stars appear as lines, because the motion of the comet was followed by the telescope.

The accompanying photographs were made on July 15 and July 20. The tails should be shown by them to have a length of 4 inches or more, corresponding to about 7 degrees. The difficulty of reproduction is so great that it is doubtful if the reader can trace them to that extent. The comet was moving rapidly among the stars during the long exposure, and inasmuch as the telescope was caused to follow the nucleus of the comet very closely, the surrounding star images are drawn out into straight lines.

The original negatives show that the details of structure in one photograph are wholly different from those in the other. Comet photography of the past ten years has determined the fact that the tails undergo very rapid transformations. The structure of one night is often entirely replaced by a different one the next night. Some force residing in the sun evidently exerts a repulsion upon the finely divided matter ejected from the head, in such a way that this material is driven in a direction opposite from the sun, and with such speed that in twenty-four hours it is usually lost in space and an entirely new tail has replaced it.

Spectroscopic observations of the present comet show that a large portion of its illumination is due to reflected sunlight; other components are due to the presence of carbon and nitrogen vapors; still others are due to the presence of vapors not yet identified.

The relation of comets to other stellar bodies, so far as their origin and the history of their development is concerned, remains extremely obscure. Why the sun should so powerfully increase the activity within a comet is entirely unknown. It has recently been proven, however, that light and heat falling upon any surface exert a minute pressure upon that surface, very much in the same way that a breath of air exerts a pressure. The supposition that these forces of light and heat acting upon the highly rarefied cometary matter may develop it in size and activity, and repel the gases in such a way as continuously to form a tail, is a most interesting and promising one.

The orbit of the comet was very accurately computed by Prof. Perrine, who found that it is moving in a parabola. It is difficult to supply a drawing showing the position of the comet's orbit with reference to the orbit of the earth, for the reason that the plane of the former makes nearly a right angle with that of the latter; to be exact, the angle between the two planes is 85 degrees. The comet has come into the solar system practically from an infinite distance, and will retire from our system never to return. The point of nearest approach to the sun will be reached on the evening of August 27, at a distance of 31 million miles. Before the publication of this note it will, no doubt, have been lost to view for a time on account of its nearness to the sun.

Metal in Yacht Construction.

The hulls of large racing yachts present many problems other than the general design and the lines. The question of material is one which constantly troubles the marine architect. It now seems that aluminium and manganese bronze are to have a competitor, if the accounts in the newspapers prove to be worthy of credence. It is said that a new metallic element (?) has been discovered and has been christened "selium." From the meager information available it seems that the new metal has certain properties which will render it invaluable for air-ship and yacht construction. It is said to be lighter and stronger than aluminium and the cost is only one-twelfth as much. On August 8, 1903, aluminium 99 per cent pure, in ingots, was quoted at 33 to 37 cents a pound in ton lots. This would make selium about 3 cents a pound. This compares quite favorably with pig-iron, which is quoted at $18.25 a ton at tidewater. It is extraordinary that a new metal should be produced at once at such an astonishingly low price. We are used to having new elements doled out from the laboratories at about $5 a look, and now we have a whole pound for 3 cents! We should be more inclined to credit the discovery if it was given to the world in a more legitimate manner.

It is not, however, its cheapness which will commend it to the yacht designer. It does not rust and takes a fine polish like nickel. If it should be found that it will not pit under the influence of sea water and that no electrolytic action sets in, it will be an ideal material for the maker of hulls to conjure with. It still remains to be seen if Mother Nature has been good to Messrs. Herreshoff, Fife, and Watson.

A decree is published fixing May 1, 1904, for presenting tenders in Santiago for the construction of the Chilian section of the Transandine Railway. The government guarantees 5 per cent on a capital not exceeding $7,500,000.

APRIL CHART (MAP VI.).

AUGUST CHART (MAP VIII.).

PROF. PROCTOR'S STAR MAPS OF THE HEAVENS IN SPRING AND SUMMER, SHOWING IN DOTTED LINES THE COURSE OF BORELLY'S COMET FROM JULY 14 TO SEPTEMBER 20, THE TIME OF ITS DISAPPEARANCE.

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Fig. 1.—Lead Mills and Mixers.

Fig. 2.—The Lead Presses.

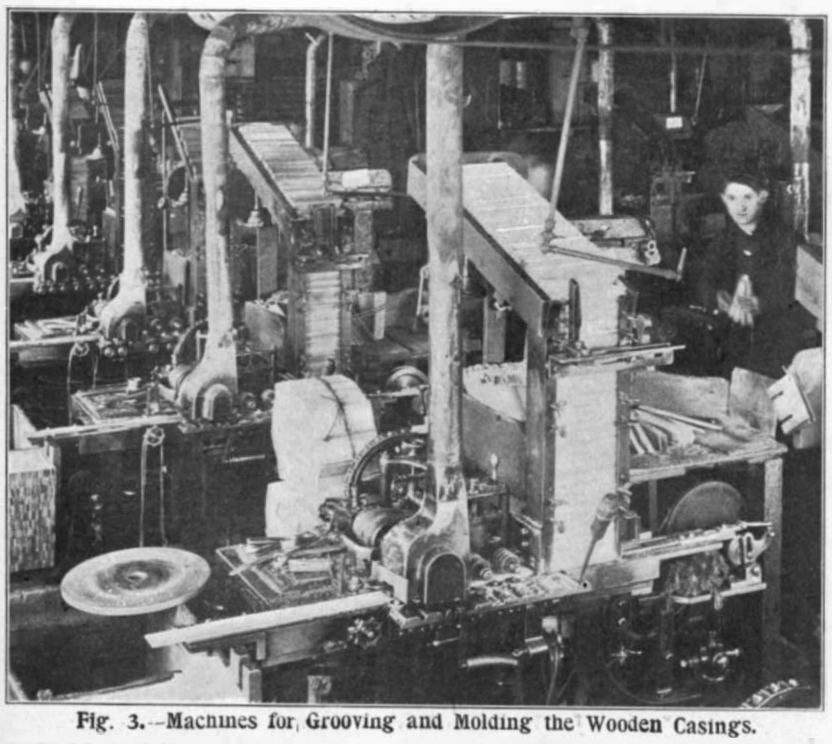

Fig. 3.—Machines for Grooving and Molding the Wooden Casings.

Fig. 4.—Gluing the Leads in Their Casings

Fig. 5. Hand Polishing the Finest Pencils.

Fig 6.—Stamping the Pencils.

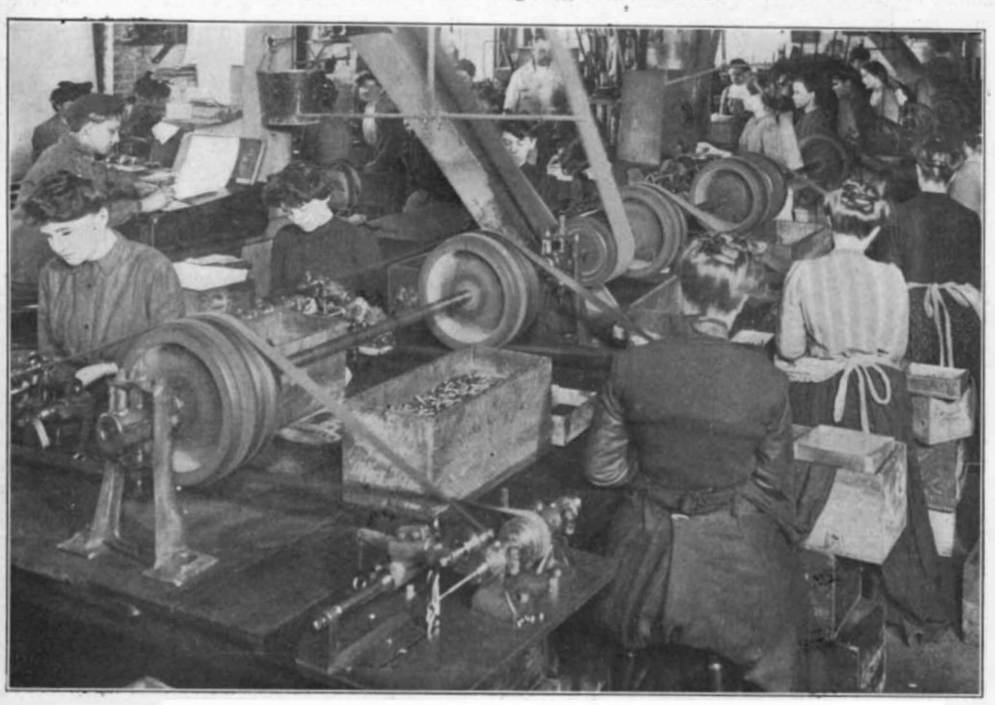

Fig. 7.—Metal Tipping.

Fig. 8.—Rubber Masticators.

THE MAKING OF A LEAD PENCIL.

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THE MAKING OF A LEAD PENCIL.

The lead pencil, so generally used to-day, is not, as its name would imply, made from lead, but from graphite. It derives its name from the fact that prior to the time when pencils were made from graphite, metallic lead was employed for the purpose. Graphite was first used in pencils after the discovery in 1565 of the famous Cumberland mine in England. This graphite was of remarkable purity and could be used without further treatment by cutting it into thin slabs and incasing them in wood.

For two centuries England enjoyed practically a monopoly of the lead-pencil industry. In the eighteenth century, however, the lead-pencil industry had found its way into Germany. In 1761 Caspar Faber, in the village of Stein, near the ancient city of Nuremburg, Bavaria, started in a modest way the manufacture of lead pencils, and Nuremburg became and remained the center of the lead-pencil industry for more than a century. For five generations Faber's descendants made lead pencils. Up to the present day they have continued to devote their interest and energy to the development and perfection of pencil making. Eberhard Faber, a great-grandson of Caspar Faber, immigrated to this country, and, in 1849, established himself in New York city. In 1861, when the war tariff first went into effect, he erected his own pencil factory in New York city and thus became the pioneer of the lead-pencil industry in this country. Since then four other firms have established pencil factories here. Wages, as compared to those paid in Germany, were very high, and Eberhard Faber realized the necessity of creating labor-saving machinery to overcome this handicap. Many automatic machines were invented which greatly simplified the methods of pencil making and improved the product. To-day American manufacturers supply nine-tenths of the home demand and have largely entered into the competition of the world's markets.

The principal raw materials that enter into the making of a lead pencil are graphite, clay, cedar and rubber.

Although graphite occurs in comparatively abundant quantities in many localities, it is rarely of sufficient purity to be available for pencil making. Oxides of iron, silicates and other impurities are found in the ore, all of which must be carefully separated to insure a smooth, serviceable material. The graphites found in Eastern Siberia, Mexico, Bohemia, and Ceylon are principally used by manufacturers. The graphite, as it comes from the mines, is broken into small pieces, the impure particles being separated by hand. It is then finely divided in large pulverizers and placed in tubs of water (Fig. 1), so that the lighter particles of graphite float off from the heavier particles of impurities. This separating, in the cheaper grades, is also done by means of centrifugal machines, but the results are not as satisfactory. After separation the graphite is filtered through filter-presses.

The clay, after having been subjected to a similar process, is placed in mixers with the graphite, in proportions dependent upon the grade of hardness that is desired. A greater proportion of clay produces a greater degree of hardness; a lesser proportion increases the softness.

Furthermore, the requisite degree of hardness is obtained by the subsequent operation, viz., the compressing of the lead and shaping it in to form ready to be glued into the wood casings (Fig. 2). A highly compressed lead will produce a pencil of greater wearing qualities, an important feature in a high-grade pencil. Hydraulic presses are used for this purpose; and the mixture of clay and graphite, which is still in a plastic condition and has been formed into loaves, is placed into these presses. The presses are provided with a die conforming to the caliber of the lead desired, through which die the material is forced. The die is usually cut from a sapphire or emerald or other very hard mineral substance, so that it will not wear away too quickly from the friction of the lead. The lead leaves the press in one continuous string which is cut into the lengths required (usually seven inches for the ordinary size of pencil), placed in crucibles, and fired in muffle furnaces. The lead is now ready for use, and receives only a wooden case to convert it into a pencil.

The wood used in pencil making must be close and straight grained, soft so that it can readily be whittled, and capable of taking a good polish. No better wood has been found than the red cedar (*Juniperus virginiana*), a native of the United States, a durable, compact and fragrant wood, to-day almost exclusively used by pencil makers the world over. The best quality is obtained from the Southern States, Florida and Alabama in particular. Eberhard Faber established his first cedar mill in Cedar Keys, Florida, in the early sixties, whence he supplied his own demand and exported considerable quantities to European manufacturers.

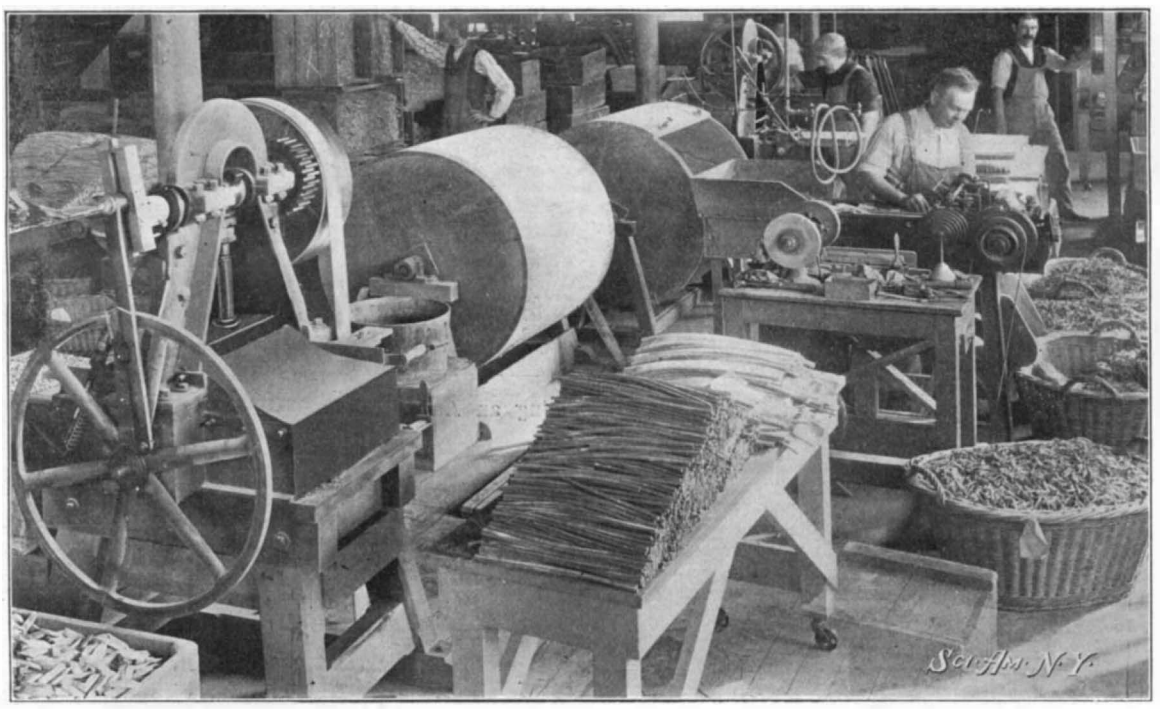

Fig. 9.—Cutting Rubber Bands and Erasers.

The wood is cut into slats about 7 inches long, 2½ inches wide, and ¼ inch thick. It is then thoroughly dried in kilns to separate the excess of moisture and resin and to prevent subsequent warping. After this the slats are passed through automatic grooving machines (Fig. 3) each slat receiving six semi-circular grooves into which the leads are placed, while a second slat with similar grooves is brushed with glue (Fig. 4) and covered over the slat containing the leads. This is passed through a molding-machine which turns out pencils shaped in the form desired, round, hexagon, etc. The pencils are now passed through sanding machines to provide them with a smooth surface.

Fig. 10.—Boxing the Rubber Bands.

THE MAKING OF A LEAD PENCIL.

After sandpapering, which is a necessary preliminary to the coloring process, when fine finishes are desired, the pencils are varnished by one of several methods. That most commonly employed is the mechanical method by which the pencils are fed from hoppers one at a time through small apertures just large enough to admit the pencil. The varnish is applied to the pencil automatically while passing through and the pencils are then deposited on a long belt or drying pan. They are carried slowly a distance of about twenty feet, the varnish deposited on the pencils meanwhile drying, and are emptied into a receptacle. When sufficient pencils have accumulated, they are taken back to the hopper of the machine and the operation repeated. This is done as often as is necessary to produce the desired finish. The better grades are passed through ten times or more. Another method is that of dipping in pans of varnish, the pencils being suspended by their ends from frames, immersed their entire length and withdrawn very slowly by machine. A smooth enameled effect is the result. The finest grades of pencils are polished by hand (Fig. 5). This work requires considerable deftness; months of practice are necessary to develop a skilled workman. After being varnished, the pencils are passed through machines by which the accumulation of varnish is sand-papered from their ends. The ends are then trimmed by very sharp knives to give them a clean, finished appearance.

Stamping is the next operation (Fig. 6). The gold or silver leaf is cut into narrow strips and laid on the pencil, whereupon the pencil is placed in a stamping press, and the heated steel die brought in contact with the leaf, causing the latter to adhere to the pencil where the letters of the die touch. The surplus leaf is removed, and, after a final cleaning, the pencil is ready to be boxed, unless it is to be further embellished by the addition of a metal tip and rubber, or other attachment.

In this country about nine-tenths of the pencils are provided with rubber erasers. These are either glued into the wood with the lead, or the pencils are provided with small metal ferrules (Fig. 7) threaded on one end, into which the rubber eraser-plugs are inserted. These ferrules are made from sheet brass, which is cupped by means of power presses, drawn through subsequent operations into tubes of 4 or 5 inch lengths, cut to the required size, threaded and nickel-plated. Eberhard Faber has a large number of these presses which are continually operated for this purpose alone. The rubber plugs used in these pencils are but one of many rubber products (erasers, bands, and the like) made in the E. Faber factory in Newark. These articles are all made from pure Para gum, which is thoroughly masticated in huge powerful masticating machines (Fig. 8), then cured, mixed with sulphur and the necessary ingredients to add to its erasive qualities, and vulcanized. The rubber is molded, and in some cases cut, to the required sizes (Figs. 9 and 10).

The Pennsylvania Railroad tunnel under the Hudson River was begun on June 25. The tunnel work is divided into two sections, known as the northern and the eastern sections. The first drill holes for the first shaft were started at noon at the foot of 32d Street and Eleventh Avenue, New York.

In addition to being an ill-smelling, noxious plant, the jimson weed (*Datura stramonium*), also known as stinkweed and stinkroot, has distinctly poisonous properties and should be exterminated wherever growing. It is recommended by the poison plant specialists of the Department of Agriculture to mow the weed while in blossom. The seeds are especially poisonous, and fatal cases are known of children eating them. Poisoning can also be produced by sucking the flower, which is an attractive-looking, very light lavender blossom. Cattle in a few instances have been poisoned by eating the leaves of young plants, where present in grass hay, but these animals either avoid the plant or are very resistant to its poison. Young plants do not contain a large proportion of poison.—G. E. M.

The Russian Department of Agriculture is offering two prizes for the best separators of average dimensions and capable of treating from sixteen to twenty gallons of milk an hour. The competition is open to foreigners, and entries must be made before February 28 (new style), 1904. The prizes will be 1,500 rubles and 500 rubles, or about $825 and $275 respectively.

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ALFALFA ON WESTERN CATTLE RANGES.

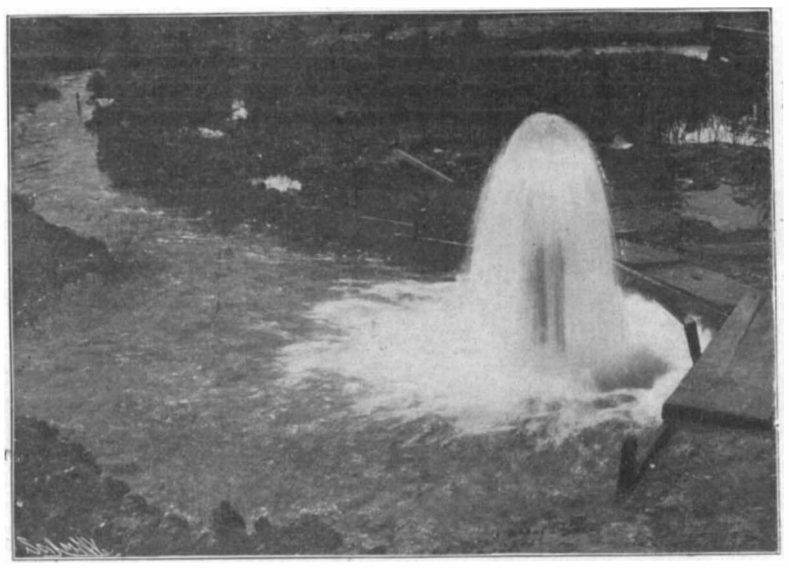
BY DAY ALLEN WILLEY.

The prediction is made that the choicest beef and mutton served on the tables of the world will be raised within a few years on the great pastures of the West and Southwest. It is known in a general way that live stock has been considerably improved recently by the modern systems which are employed on ranches; for no longer is the flesh driven off the bones of the cattle in forcing them to go mile after mile over plain and valley in search of new feeding grounds. Many of the ranches of to-day are divided into pastures, which, though perhaps covering 50 or 60 square miles in extent, are provided with an abundance of fodder.

While the majority of the great herds and flocks of the West as yet are of medium and low grade stock, the tendency is to breed a higher grade of animals; for the ranchmen have realized that they can grow a kind of food which is especially suitable for such varieties as Herefords, Devons, Holsteins, and Durhams in cattle, as well as even Merino and Southdown sheep. This food is alfalfa, which is perhaps one of the greatest blessings which has been bestowed upon the western farmer and stock raiser. Alfalfa is another name for lucerne and in the Southwest is called Spanish clover, because its foliage resembles this clover to a certain extent. It is an attractive plant and only a few years ago was considered far more ornamental than useful. Now, however, it has been discovered that not only horses and mules but cattle and sheep thrive upon it and will eat it in preference to any other grass that grows. The farm experts say that it contains as much nourishment for live stock as corn and is as good as the best timothy or other ordinary hay.

Alfalfa is an importation, being brought to the United States first in 1842, when some seed secured from France was planted in New Mexico. The first harvest was considered of little value and for a number of years the crop was neglected, but the vegetation from the first field began spreading over that portion of the State until to-day there are many miles of territory upon which nothing else is grown. It is especially adapted to the arid lands of the West, for it grows luxuriantly with a very small amount of moisture. In the irrigated districts it has become one of the principal forage crops and is as extensively raised in Colorado as in the southern part of the country and more and more is being raised as the farmers appreciate its value.

Alfalfa grows so rapidly that in six months the mower can go over the field four or five times and cut off from 1½ to 2 tons an acre at each harvest. As many as seven crops have been gathered in Colorado and New Mexico when special attention is given it. The seed is planted in the spring of the year, about 25 pounds being enough for one acre. The ground is first prepared by plowing and after the seed is in, it is kept fairly free from weeds until the plant secures a start, when it does its own weeding. In fact it is very independent and practically takes care of itself until it is ready for the blade of the harvester. It can be piled or stacked like timothy or any other forage crop, and when properly piled in a field is proof against the weather. Sometimes it is pressed into bales and stowed away; but most of the large ranch owners grow it in convenient places, stacking it up near their pens and pastures. They get a great deal out of their alfalfa fields for a small amount of money, for the average cost of the seed, cultivation, harvesting and stacking is only about $1.50 a ton, where four crops are gathered in a season. One reason for the low cost of making the crop is that the ordinary horse cultivators and harvesters can be used, thus saving time and labor. It grows so luxuriantly that a few weeks after the seed is sown, the plant may be knee-high, and sometimes waist-high in the field. Cattle and sheep eat it with the same relish whether standing green in the field or pulled dry from the stack. After the harvest, sometimes hogs are turned into an alfalfa pasture and they actually fatten on it. It not only makes flesh, but a fine quality of flesh. Beef and mutton fed on it have an excellent flavor, usually superior to that coming from the ordinary ranches, where various grasses are depended upon for food, and where corn is also used for fattening.

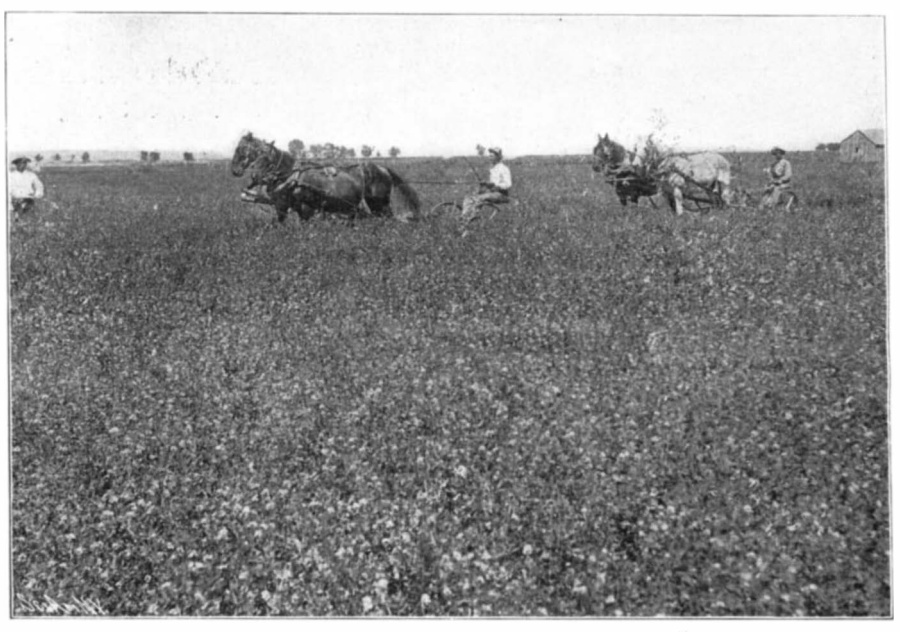


An Artesian Well for Irrigating an Alfalfa Field.

The reports made to the Department of Agriculture from the various irrigated districts in the West show a surprisingly large number of flocks and herds of high-grade animals. In fact the proportion in these sections is much larger than elsewhere in the country beyond the Mississippi River. It is due to the fact that the irrigation farms are raising so much alfalfa. In the Pecos Valley in New Mexico there are herds aggregating 500,000 head of Hereford and Durham cattle alone. Some of the single herds contain 30,000 animals, while it is estimated that fully half a million blooded sheep are contained in the flocks which graze in the same vicinity. In the valley of the South Platte, Colorado, are also immense droves of blooded animals and fully 100,000 cattle are now being sent to Kansas City, St. Louis, and Chicago which have been raised almost entirely on alfalfa. The packers pay the highest market price for these grades. They are largely exported on the hoof and in carcasses and many an Englishman dines on roast beef "made in America," but coming from stock which originally was raised in Devonshire or perhaps Durham.

The tendency among the western cattle growers is to raise more quality and less quantity, and for this purpose a number of very valuable herds of pure-blooded stock have been imported within the last few years from Great Britain. Nearly every large ranch has at least one or two registered bulls and as fast as possible live stock growers are improving their strain. There should be no danger, however, of a meat famine on account of this revolution in cattle raising, for last year government statistics showed fully 25,000,000 beeves, nearly 50,000,000 sheep, and about 30,000,000 hogs owned by farmers and ranchmen in the United States.

Western Cattle, Raised on Reclaimed Desert Land and Fattened with Alfalfa.



A Field of Clover.

Pens on a Western Sheep-Ranch, where the Animals are Fattened with Alfalfa.

ALFALFA ON WESTERN CATTLE RANGES.

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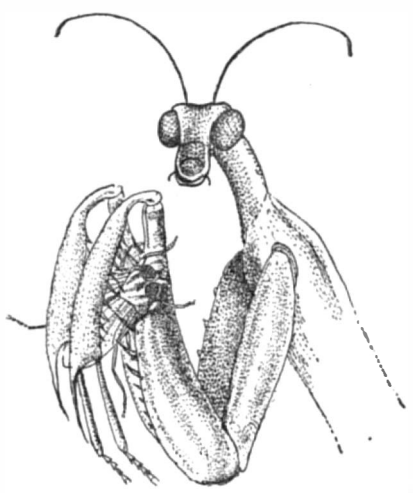
FLOWERS OF PREY.

BY J. CARTER BEARD.

Probably in some respects the most surprising result of late entomological exploration is the discovery of semblances of orchidaceous flowers endowed with animal life and voracious carnivorous appetites, that seize and incontinently devour insect vegetarians which, allured by their form and color, incautiously alight upon them. These flower insects belong to the curious family Mantidæ, of which we have a well-known member in our southern States, *Phasmomantis Carolina*, commonly called "praying mantis," though if the first part of the name was spelled with an "e" instead of an "a," it would be far more appropriate, since no known insect is more bloodthirsty and destructive of smaller and weaker individuals belonging to its class. Its form is characteristic of its predatory habits. The mantis is really a four-legged insect, for the fore limbs are so modified that they cannot under any circumstances be used in walking and are no more properly termed legs than would be the arms of men or the wings of birds. They are, in fact, the natural weapons of the insect and are used for nothing else than fighting and for capturing prey.



Upper Part of American Mantis with an Insect Which It is About to Devour.

The insect shown at Fig. 2, discovered by Wood Mason, masquerades sometimes as a pink and at others as a white orchid. The whole flower insect is either conspicuously white or of a resplendent pink color, and both in color and form perfectly imitates a flower. The lower or apparently anterior petal of an orchidaceous blossom, the labellum, often of a very curious shape, is represented by the abdomen of the insect, while the parts which might be taken, regarding it as an insect, for its wings, are actually the femurs of the two pairs of posterior limbs, so greatly expanded, flattened, and shaped in such manner as to represent the remaining petals of the flower. As the mantis rests, head downward, amid the stems and leaves of a plant, the fore legs drawn in so that they cannot be seen, the thighs of the two hind ones radiating out on each side, and the thorax and the abdomen raised at right angles to each other, the insect might easily at first sight deceive more discriminating entomologists than the honey-seekers that settle upon it. An allied species, exactly resembling a pink orchid, is mentioned by Dr. Wallace, on the authority of Sir Charles Dilke, as inhabiting Java. Its specialty is alluring and capturing butterflies. The expected guest having arrived, the seeming feast spread out for his delectation arises and devours him. Prof. S. Kurz, while at Pegu, in lower Burma, saw what he supposed to be an orchid of a species unfamiliar to him, but upon examination found it to be a mantis of the genus Gongylus. As is common with the habit of its kind when alighting upon a plant, it hung head downward, exposing the under surface to view, sometimes motionless, and sometimes swaying gently like a flower touched by gentle zephyrs. A bright violet-blue dilation of the thorax, in front of which its fore legs, banded violet and black, extended like petals, simulated the corolla of a papilionaceous flower so perfectly as to deceive the eyes of a practised botanist. An account is given in the proceedings of the Asiatic Society, Bengal, of a number of specimens of this mantis in the possession of Dr. J. Anderson. These insects came from Mindipur. Santal women and children had collected them from the twigs of a bush where they were hanging and brought them alive to a Mr. Larymore, who forwarded them to Mr. Buckland, who in turn gave them to the doctor.

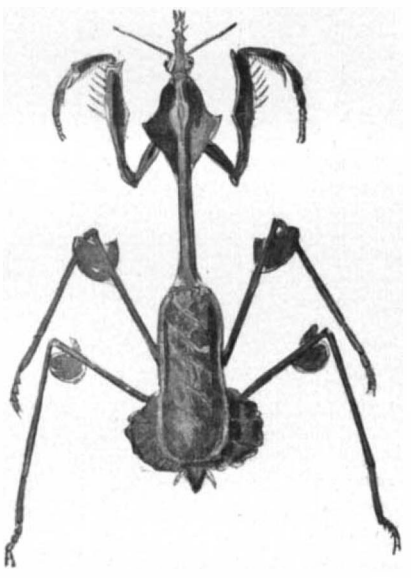
Deroplatys Truncata (Truncated Mantis), from Singapore.

They are said to particularly frequent rose bushes, and at Mindipur are known as rose-leaf insects. Their wings, when the mantis is mature, are furnished with foliaceous expansions that perfectly counterfeit rose leaves. They were fed upon flies and grasshoppers, preferring the flies because the grasshoppers were evidently too vigorous for them to easily manage. The insects were immature; they did not exhibit, looking at their upper surfaces, any particularly striking peculiarities, except the leaf-like dilation of the prothorax, and the foliaceous appendages to the legs, all of which, together with the rest of the upper parts of the insect, was green. On the other hand, the mantis presents an entirely different appearance when its under surface is exposed to view. The leaf-like expansion of the prothorax, instead of green, presents a pale, clear lavender-violet hue with a faint pink bloom along the margin. The resemblance to the corolla of an orchidaceous flower thus presented is perfected by the presence of a dark brown spot in the middle over the prothorax or breast, which looks precisely like the mouth of the tube of a corolla. In addition to this, the long, slender upper part of the prothorax resembles a flower, while the fore limbs, when resting drawn up in the center of the corolla, add to and heighten the imposture.

The curious forms shown in our illustrations belong to the same genus, Deroplatys, although the first is a native of Singapore, south of the Malay Peninsula, while the Sarawaca is from Borneo. In these species the outspread wings simulate the petals of a flower.

A whole tribe of spiders, members of the Thomisadæ family, living in flower cups, assume the colors and markings of the flowers in which they lie in wait for victims.

Blossoms of the *Vibernum lantana*, a European shrub having large ovate leaves and dense cymes of small white flowers, and it may be added, our American species (*Vibernum lentago*), or sheep berry, also bearing broad, flat clusters of white flowers, are at times occupied by spiders of the same creamy-white hue as that of the blossoms, and their globular abdomens mimic the unopened buds (of which there are many in each cluster) not only in color but in shape and size. These spiders spin no web, depending upon strategy to secure their prey, and live upon their insect visitors. Later in the season spiders apparently identical with these, except in color, are found in the blossoms of the *Orchis maculata*. The spiders found here have dark reddish-brown spots on the abdomen; and in the position usually assumed by it, the Aranima, standing with depressed head, closely mimics in shape and size, in relative position, and a little way off in color, the dark purple pollinia of the flowers. Recent investigations render it extremely probable that, as first suggested by Prof. Nottridge, as the season advances, these spiders change color, and that each successive change adapts them for concealment in the flowers of some particular plant. The *Thomisus citrens* poses itself in the middle of a composite flower with legs expanded like its exterior ray. They have been observed in orchidaceous flowers with their legs expanded horizontally. Honey-bees as well as other insects have been found in their murderous clutches.



Immature Form of Rose-Leaf Mantis of the Genus Gongylus, from India.

Deroplatys Sarwace, from Borneo.

Curious Orchid Lately Discovered by Wood Mason.

Brazilian birds, flycatchers, display a brilliantly colored crest easily mistaken for a flower cup. Insects, attracted by what appears to be a freshly opened blossom, furnish the birds with food. An Asiatic lizard is entirely colored like the surface of the desert plains where it lives, except that at each angle of the mouth blooms a brilliant red folding of the flesh exactly resembling a little flower that grows in the sand. Insects lured by the seeming flower are incontinently disillusioned when they settle upon it.

FLOWER TRAPS.

In the city of New York there are only 737,477 white persons born of native parents.

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RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRIC AUTOMATIC GAS LIGHTER AND SHUT-OFF.—H. J. LYONS, Guyandotte, W. Va. This invention relates to an electric automatic gas lighter and shut-off, Mr. Lyon's main object being to provide for igniting a plurality of burners stationed at different points and to provide for automatically shutting off the gas, so as to prevent the gas being turned on again under conditions of danger. The small motor in this contrivance may be made with permanent magnets so as to reduce the cost of the batteries to a minimum. An independent circuit can be added for the separate lighting of individual burners.

SPHEROIDAL STRAIN.—L. STEINBERGER, New York, N. Y The invention relates to electrical strains, the inventor's more particular object being to produce a neat, compact, and efficient device capable of being used either with or without the outer envelope or insulation. The device is one very easily handled in machine shops, for the reason that the link can be either drop-forged or cast from malleable iron.

SINGLE-LINK STRAIN.—L. STEINBERGER, New York, N. Y. This improvement belongs to insulated electrical strains used for outdoor wiring, and more particularly to the production of a strain embodying a high degree of simplicity, neatness, cheapness, and general efficiency. It further relates to the production of a strain in which there is virtually but a single "metallic link."

SUSPENSION-FIXTURE.—L. STEINBERGER, New York, N. Y. The invention in this patent has reference to a suspension-fixture to be used in overhead-line construction for electric railways, and more particularly as a device capable of serving as a turnbuckle, a strain, and a clip support; and the object of the inventor is to produce a device capable of serving in one or more of the capacities mentioned.

Engineering Improvements.

SUCTION-VALVE FOR COMPRESSORS.—E. A. MENKING, Pittsburg, Pa. The present invention pertains more especially to spring-controlled puppet or suction valves, such as are employed in connection with cylinders of air, gas, or other compressors or the like; and the principal object is to provide a valve structure of this character which is effective in operation and which may also be regulated with facility, whereby no hammering or noises are produced by the valve when the same is in use.

RANGE-FINDER.—G. GRIFFITH, San Francisco, Cal. The object in view of the invention is to furnish a new and improved range-finder for the use of surveyors, marine officers, and other persons and arranged to indicate the distance of an object from the observer located on land or sea without requiring calculations.

PIPE.—O. BERGER, Galveston, Texas. Stated broadly, this invention consists of arranging the fluid or gas conducting pipe within a larger pipe and special means whereby the inner pipe is concentrically supported, providing uniform surrounding space between it and the outer pipe, adapted to receive insulating-packing, or for effective flow of cold fluid around the inner pipe, according to whether its contents are to be cooled or heated.

EXPLOSIVE-ENGINE.—W. WALKE, Joplin, Mo. Mr. Walke's invention has reference to improvements in explosive-engines of the two-cycle class, the engines being adapted for service in either a horizontal or a vertical position. The engine has its parts arranged for operation in a manner to minimize the vibration of the structure, thus especially adapting it for service on motor driven vehicles.

MOTOR.—J. W. GARRETT, New York, N. Y. The inventor's improvement in this patent refers particularly to that class of motors known as "gas" or "explosive" motors, his object being to provide a simple and inexpensive means for converting a steam or similar pressure engine of the ordinary slide-valve type into a gas-motor of high power.

BOILER-SETTING.—S. W. DAVIS, Pickens, W. Va. In this case the invention resides in a manner of constructing walls adapted especially for covering or setting boilers, although it is applicable to various other purposes, as will suggest themselves to skilled mechanics—for example, it could be used in wall construction in the art of house-building.

Hardware.

PERMUTATION-LOCK.—R. L. BENTON and W. R. BENTON, Salida, Col. The object claimed in this invention is the provision of simple novel details of construction for a lock that adapt it for reliable service to secure a door in closed adjustment, dispense with a key, and which is devoid of accessible openings, thus preventing the use of explosives for destroying the lock when it is in locked condition.

Heating Apparatus.

FIRE-BOX FOR FIREPLACES.—J. J. M. LANGE, Svendborg, Denmark. The design in this invention is to retain the advantages and avoid the drawbacks in well-known types of slow-combustion stoves. This result is obtained by the fact that the improved fireplace, in which the combustion takes place from above downward, comprises a container for the fuel, having openings for the introduction thereof and for the passage of air, and in which container the remaining embers can by means of a turning movement be pushed upward and spread out over the fresh fuel.

Machines and Mechanical Devices.

HOIST, RAISED TRACK, AND DUMPING DEVICE.—W. R. STRICKLER, Jewell, Kan. The object of this device for loading hay, grain, and other materials into barns or other buildings and places, is to provide an improved horse-power hoisting device, very effective and automatic in operation, and arranged to utilize the power applied to the fullest advantage, and to automatically trip off a load and cause return of the load-carrier to the starting position.

ICE-MAKING MACHINE.—R. F. LEARNED, Natchez, Miss. The improvement relates to machines of that class wherein water is frozen into blocks of ice in suitable cans; and relates more particularly to apparatus wherein air or gas is admitted to the water during the freezing operation in order to deaerate the water and to produce a solid and practically coreless block of commercial ice. Such an apparatus is disclosed by a prior application for a patent by Mr. Learned.

APPARATUS FOR RAISING LIQUIDS FROM WELLS.—T. F. MORAN, of De Young, and F. J. MOSER, Kane, Pa. The invention relates to apparatus for raising liquids from wells, and more particularly to apparatus of the kind used in the oil regions for raising liquids, such as oil and water, from oil-wells. It also relates to mechanism for cleaning the sand and other impurities from the well, and also to render the main valve, used in the bottom of the well, more readily accessible.

WORD-COUNTING ATTACHMENT FOR TYPE-WRITERS.—J. G. COLEMAN and L. WILHITE, Cleburne, Texas. The present invention relates to improvements in word-counting or registering attachments for type-writing machines, the object being to provide a device for this purpose of simple construction that may be readily attached to the machine and by means of which the number of words printed will be accurately indicated.

SPOOL-CUTTING LATHE.—G. A. ENSIGN, Defiance, Ohio. Mr. Ensign's invention has reference to woodworking machinery; and the inventor's object is to provide a new and improved spool-cutting lathe more especially designed to finish roughened-out spools in a very simple manner, rendering the spools uniform in shape and finish and allowing the finishing of spools of different shapes and sizes.

WAVE-MOTOR.—J. C. HERGENHAN and C. C. VON DER AHE, New York, N. Y. In this patent the invention relates to certain novel and useful improvements in the construction of an apparatus designed to utilize motion imparted by waves. The object is the provision of a mechanism which may be readily assembled upon a hull or float of the desired character and which shall be so constructed that it shall be positive in its operation and simple in construction.

MECHANICAL MOVEMENT.—J. H. HUSSEY, Spokane, Wash. Broadly stated, this invention comprises mechanism interposed between the driving power and the work it operates upon whereby the power derived from a reciprocating motor is evenly delivered to the work. Taking for illustration the commonest form of motor now in use, the steam-engine, it is well known that the power derived therefrom is delivered with constant variation, according to the position of the crank-shaft of the engine, position of the piston, etc.

Of Interest to Farmers.

MACHINE FOR LOADING AND STACKING HAY OR THE LIKE.—S. MITSCH, Woodbine, Kan. One of the principal objects of the improvement is to provide means whereby hay, grain, or the like may be loaded upon the machine while the latter is in motion, and also to furnish means whereby the elevation of the load is effected during the movement of the apparatus toward the stack.

SACK-SCALE.—G. A. ARCHAMBAULT, Clare, Mich. Comprised in this improvement is a supporting-frame which is capable of adjustable attachment to a bin, wagon, or the like, and which carries a scale-beam. To the beam is attached the bag-holding device. By means of this invention grain may be shoveled readily into the bag and at the same time weighed, after which the bag may be tied and a second filled, the work being carried on quickly and conveniently.

PLOW.—J. N. HATCHER, Mokane, Mo. The purpose in view in this improvement is the provision of a plow that may be readily changed to form either a sulky or walking plow, as may be desired, and, further, to provide, in connection with the plow, a soil-cutting or turning disk or moldboard so attached that it may be swung to operate on either side of the plow.

Of Mining Interest.

SHEET-METAL CLAMPING-BAND WITH INCLINED LOOSE DISPLACEABLE JOINT FOR PIPE-UNIONS.—E. WIRTZ, Schalke, Germany. This invention has relation to certain novel and useful improvements in a device for uniting cylindrical pipes, and in particular to thin-walled pipes and butt-joints—such as are used for air-conduits in mines and for other places. This clamping-band for pipes can be manufactured in great quantities at comparatively little expense.

BUMPING-SCREEN.—H. L. KING, Denver, Col. This is a screen for classifying and sizing ores in milling. The invention includes, in connection with a supporting frame, screen-hangers located below the weight of a screen-body and so disposed relatively to the main frame and the screen whereby a vertical rolling movement of the screen is effected simultaneously with the longitudinal movement or thrust thereof.

TREATMENT OF ORES CONTAINING GOLD, SILVER, COPPER, NICKEL, AND ZINC.—H. HIRSCHING, San Francisco, Cal. This is a process whereby the metals of complex and refractory ores and tailings can be extracted, and more especially gold, silver, copper, nickel, and zinc can be produced separately and economically. The process is a continuous hydrometallurgical process, using as a solvent water, ammonia, and compounds thereof, and is carried on in a simple apparatus for which a separate application has been filed by Mr. Hirsching.

Pertaining to Vehicles.

VEHICLE FRAME AND DRIVING AXLE GEAR.—GEORGE R. BOULDING, Wells, Nev. Mr. Boulding's invention provides means of connecting the front as well as the rear axle of an automobile to the driving motor. This is permitted by the use of an improved type of swivel hub whereby the wheels may be steered independently of the front axle, and the outer wheel may turn faster than the inner one in turning a curve. The frame of the vehicle is so constructed that the vehicle will ride easily over an uneven road with all four wheels continuously in contact with the ground.

REACH OR COUPLING-POLE FOR VEHICLES.—J. PREUITT and C. W. F. GLANDER, Wahpeton, N. D. The principal object of this invention is the provision of a reach or coupling-pole for wagons and similar vehicles which is extensible as to length, whereby the same may be adapted to vehicles in which variations may exist in the relative distance between the axles thereof or between the rear-ward axle and the usual bolster above the forward axle of the vehicle.

SPROCKET-TOOTH.—R. O. WIGLEY, Brewton, Ala. In the present case the improvement consists in making the central tongue of a sprocket detachable from the fork portion and securing it within a socket of the fork portion by the same bolt which fastens the sprocket to the wheel. By this construction a great saving in sprockets is made, for as the pulling strain and wear come only on the central tongue it is only necessary to renew the tongue or to take it out and turn it around without having to cast away or change the position of the entire sprocket.

Railways and Their Accessories.

METALLIC RAILROAD-TIE. — J. K. THOMA, Cooperstown, N. Y. The purpose of this inventor is to provide a metallic tie for railroads so constructed that rails of any description will be firmly held in place and the locking device for the rails utilized not only to hold the rails upon the ties, but also to anchor the ties and to prevent the ties and rails from creeping or moving from their set position.

CAR-DOOR.—F. L. MONSON, Christine, N. D. In this patent of Mr. Monson the invention has reference particularly to doors for grain-cars, and the object of the improvement is to provide a metal door of very light material, and therefore easy to handle or operate, and, further, to provide means to make the door grain-tight.

DERAILER.—M. P. LAYTON and J. W. VAN DOREN, Minonk, Ill. In this case the invention relates to a device for running railway rolling-stock from the rails. It is applicable in various connections, particularly on sidings or switches, so as to prevent the cars on the switch from being run back accidentally onto the main track. The entire action of the derailer is automatic.

Miscellaneous.

HALTER.—J. G. LEWIS, Fairfield, Neb. Mr. Lewis has invented an improvement relating to halters, which is a simple, neat, and efficient device composed entirely of two pieces of rope and readily adjustable to the heads of different-sized horses. His device also allows considerable freedom to the jaws of the animal, and it can be operated by a farm hand of ordinary intelligence.

REMINDER.—V. STERKI, New Philadelphia, Ohio. This contrivance is an instrument for reminding persons of business engagements and other events desirable to be borne in mind. The device is equally serviceable for business men, doctors, lawyers, ministers, teachers, statesmen, and politicians. It may be advantageously used in the home, especially by people having many social duties.

FOLDING AND CREASING DEVICE.—H. R. PLIMPTON, 2d, Newton Center, Mass. The purpose of this inventor is to provide means used in connection with a circular or other form of base for folding and creasing galloons, bindings, tapes, and ribbons of paper and other material through the medium of which means the material may be taken from the base in either a folded or creased condition or in its usual flat condition.

PERMANENT HAT-PIN AND LOCKING ATTACHMENT.—C. C. G. WOLPERS, New York, N. Y. The intention of this improvement is to provide a pin which while removable from the hat is adapted to remain as long as the hat is in continued use or even thereafter and to provide the pin with one or more comb-sections removably applied thereto adapted to enter and take up such a binding engagement with the hair when the hat is placed upon the head and the pin is properly turned as to hold the hat in place.

CONDUIT OR CULVERT.—L. LANE, Toledo, Ohio. In carrying out this invention Mr. Lane has particularly in view a structure, the parts of which may be readily shipped from point to point in sections or detached portions and may be quickly and easily assembled and bound or held in such assembled position through the medium of his improved devices.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Morgan Emery wheels. Box 517, Stroudsburg, Pa.

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Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 4484.—For machine for turning wood handles for bucket bailing, tub handles, etc.

Mechanics' Tools and materials. Net price catalogue. Geo. S. Comstock, Mechanicsburg, Pa.

Inquiry No. 4485.—For makers of furnaces for melting, casting, etc.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 4486.—For a plant for the manufacture of wood charcoal and pyroligneous acid.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 4487.—For manufacturers of an inside tube cutter.

Machinery designed and constructed. Gear cutting, The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 4488.—For makers of wind mills.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 4489.—For firms that manufacture and supply dealers or jobbers with electric insoles.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 4490.—For the manufacturers of Prof. Wingren's electric insoles.

Contract manufacturers of hardware specialties, machinery, stampings, dies, tools, etc. Excellent marketing connections. Edmonds-Metzel Mfg. Co., Chicago.

Inquiry No. 4491.—For makers of steam motor cars.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadri... Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 4492.—For makers of petroleum launches, having a self-starting engine.

WANTED.—A gas producer engineer or draftsman familiar with construction and operation of gas producer. State experience. Weber Gas and Gasoline Engine Co., Kansas City, Mo.

Inquiry No. 4493.—For all sorts of electric dynamos for lighting, nickel, and electroplating purposes.

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Inquiry No. 4494.—For makers of foot power launches.

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Inquiry No. 4498.—For the name and address of the builders of the "Essex" hot air engines.

Inquiry No. 4499.—For makers of electric motor wheel chairs.

Inquiry No. 4500.—For makers of lumber planers and matchers.

Inquiry No. 4501.—For makers of adding machines.

Inquiry No. 4502.—For makers of a light die press which will bolt to the bench, and will punch out 4-inch round checks of thick press board, cardboard, light brass and heavy tin.

Inquiry No. 4503.—For machinery for rolling out gum or manufacturing chewing gum.

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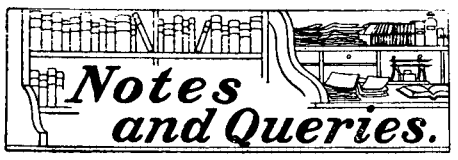

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(9157) R. A. N. says: 1. What apparatus is necessary to install telephone apparatus cn a telegraph line? We wish to use only transmitters and receivers and such other as is necessary, using the telegraph battery as battery for the telephone. A. To use a telegraph line with a telephone it is only necessary to attach the transmitter and receiver to the line. The telegraph battery will answer for both services. The sounder may answer for the calling apparatus. 2. There is anotner telephone line on our poles; why is it that we can hear them talking while the lines are 18 inches apart? A. What you hear from one line to another is called "cross talk." It is due to the electric waves which fill the space around the wire. 3. When the lines get crossed we can hear them talk by putting an ear close to the sounder. Why is it? A. The sounder of a telegraph has long been known to be able to receive a telephone message. It is because the sounder is affected by the waves and vibrates just as the diaphragm of the receiver does. 4. I have read that the electricity flows around the surface of a wire and not through it. A. Electricity of very high voltage, as that of the lightning, does not penetrate a wire, but flows on its surface. This is not the case with the current from a battery. It penetrates the metal and goes through the wire. 5. Will a rusty wire offer more resistance to its passage than a galvanized wire? A. From the answer to the last question you will see that if a wire is rusty upon its surface only, it can conduct electricity as well as if bright; but if the wire is so much rusted that its body is reduced by the rust, it is equivalent to a wire of the size of its unrusted portion, and cannot conduct electricity as well as one unrusted, of its former full size.

(9158) M. E. C. asks: I wish to put a telephone line from our house to one of our greenhouses a distance of about 320 feet. Will you please tell me the best way of running the wires underground? Are the lead-incased wires durable enough to be buried directly in the ground or should they be run through pipes? A. The lead-incased cables can be run by laying them directly in the earth. They are very durable unless a break occurs in the sheath. To prevent injury from this cause, it is better to use the cable with a core saturated with an insulating substance which repels moisture. These can be obtained with one or more pairs of conductors.

(9159) A. H. F. says: I would like for you to answer these inquiries either by letter or through your Notes and Queries column. I would like to know at what speed a trolley can be run constantly or can it be run at the rate of 60 or 70 miles an hour, with stops at about 35 or 45 miles, without injury to the wires or trolley contacts, such as pulleys. I think it is impossible to run a trolley and keep proper contact at the rate as stated above. Can you tell me what line and where the highest speed is run and what distance runs are made without stops of about 35 or 45 miles? A. Trolley cars can be run constantly at any speed which they can attain at any time, if the roadway is safe and there is no break-down. There is nothing to prevent this in the trolley wheel or shoe of the contact with the third rail. Forty to fifty miles per hour has often been made for a short time, but cannot be maintained on any road because of stops and grade crossings with highways. An experimental track is in existence in Germany upon which over 100 miles an hour has been made. If there was any need of such a road electrical engineers would undertake to build and operate an express road with 60 miles per hour and stops at any interval desired. But there is no one to put up the capital for such a road, since it is not needed at present.

(9160) J. E. J. says: There are several gasoline engines in this town and the spark or battery gives us more trouble than a little. Will you please answer in Notes and Queries what is the best battery, liquid or dry, for a small (1½ horse power) engine. Have you a SUPPLEMENT that gives full information? A. Dry cells are usually employed for sparking gasoline engines. See Hiscox's "Gas Engines" for a full treatment of the matter; price $2.50 by mail.

NEW BOOKS, ETC.

CHEMISCH-TECHNISCHES REZEPTBUCH FUER DIE GESAMTE METALLINDUSTRIE. Von Heinrich Bergmann. Vienna: A. Hartleben. 1903. 12mo. Pp. 327. Price, $1.50.

Mr. Bergmann has collected a great number of recipes which should be of value to the metallurgist, particularly since the recipes which he has gathered are such as have proven themselves of practical value.

EMERY GRINDING MACHINERY. A Text Book of Workshop Practice in General Tool Grinding and the Design, Construction, and Application of the Machines Employed. By R. B. Hodgson, A.M., I.M.E. London: Charles Griffin & Co., Ltd. Philadelphia: J. B. Lippincott Company. 1903. 12mo. Pp. 180.

An emery grinder is one of the most useful tools a shop can have, especially as a money saver. The present volume is an admirable contribution to the literature of money machine shop work. Unlike many English technical books, American practice is far from being neglected, and many of the best American types are shown.

WOOD. A Manual of the Natural History and Industrial Applications of the Timbers of Commerce. By G. S. Boulger, F.L.S., etc. London: Edward Arnold. New York: Longmans, Green & Co. 1902. 16mo. Pp. 369. 66 illustrations, 3 plates. Price, $2.60.

About 750 woods are enumerated in this excellent book, including most of those which are practically known in general commerce. The information is of a very practical nature, dealing with the weights of wood, their hardness and color, odors and resonance, the defects of wood, seasoning of wood, the uses of wood, and a complete catalogue and an excellent bibliography.

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AND EACH BEARING THAT DATE.

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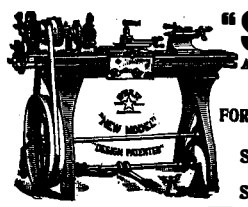

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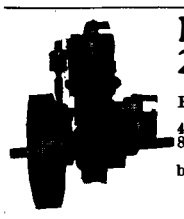

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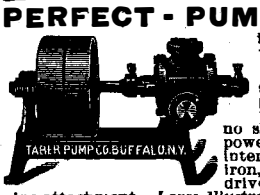

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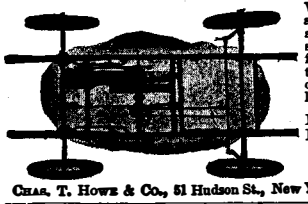

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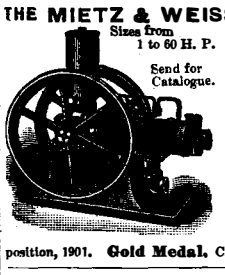

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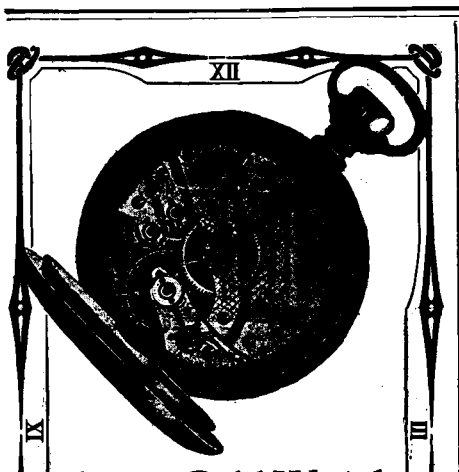

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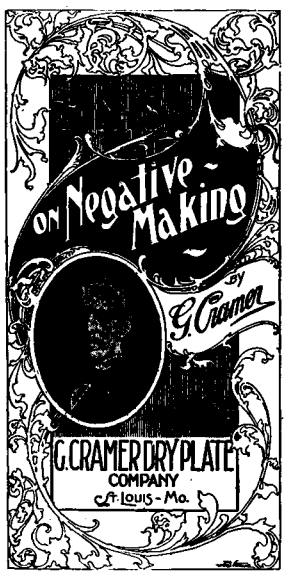

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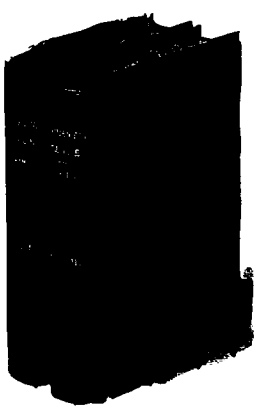

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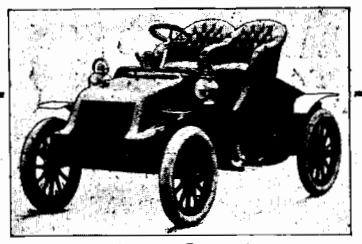

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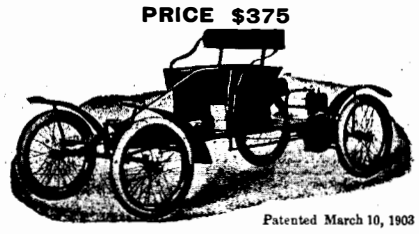

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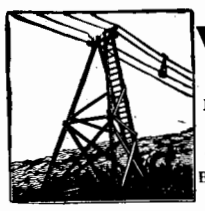

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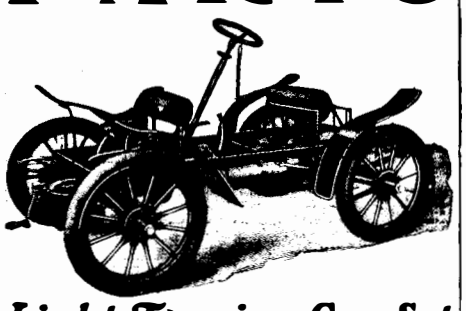

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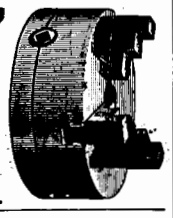

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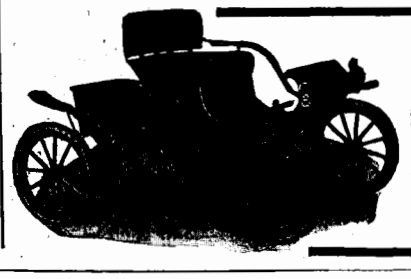

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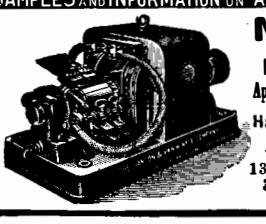

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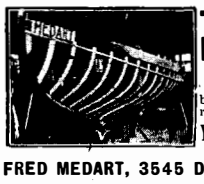

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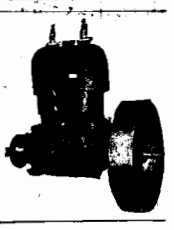

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